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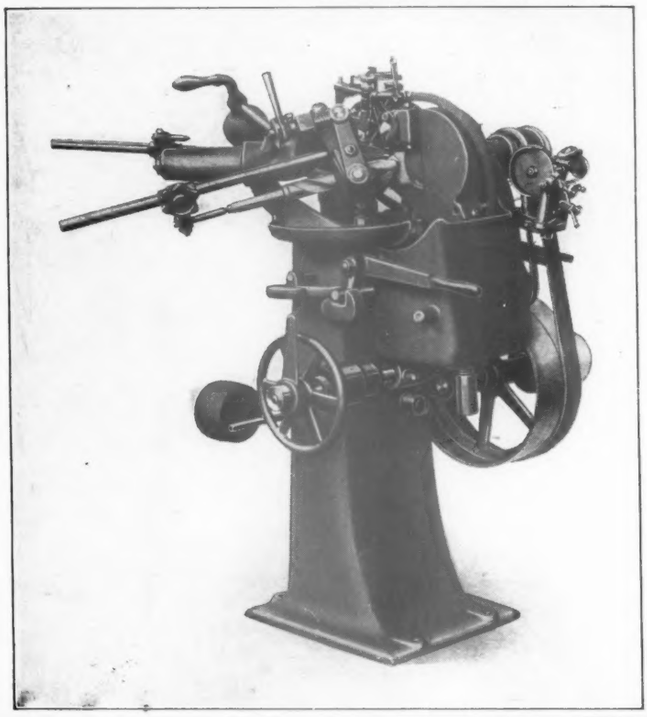

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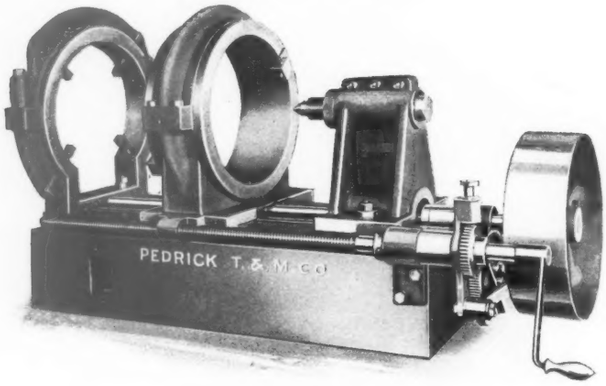

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Railway Mechanical Engineer

Volume 91 November, 1917 No. 11

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Enginehouse Terminal Competition

Contrary to our expectations, it has been impossible to publish in this issue the prize winning articles of the enginehouse competition which closed October 22. There were a number of contestants and the judges have not had an opportunity to study the papers sufficiently to award the prizes. The decisions will be made shortly and those to whom the prizes are awarded will be so advised. This problem is exceedingly important at this time and was made the subject of a paper before the Western Railway Club, which is published elsewhere in this issue. Particularly good suggestions are brought out in this paper, which should be carefully studied.

The M. C. B. Seven Hundred Pound Wheel

The new design of seven hundred pound wheel for forty ton cars adopted by the Master Car Builders' Association appears to have certain important advantages. The performance will be watched with great interest when this type is placed in service. The principal object of the new design is to lessen the liability of cracks occurring in the plate of the wheel. Cracked plates are not only one of the most dangerous defects in wheels, but also one of the most difficult to detect. The examination of a large number of standard M.C.B. cast iron wheels which failed in the plate showed that there was a tendency for sand to gather at the re-entrant curve of the outer face of the plate, thus reducing the effective strength at that point. In the new arch plate wheel the section has been made thicker and the curvature has been changed at this point to do away with the tendency for sand to gather in the mould. It seems reasonable to assume that the alterations made in the design will result in a considerable reduction of the wheel failures due to defects in the plate.

Do Not Slight the Work Reports

Upon the running repair forces at the engine terminals rests to a very large extent the success with which the power is maintained and made to perform its full duty. An engine failure at this time is more than ordinarily expensive and the locomotives are more liable to failure because every opportunity is taken to overload them. This means that they must be kept in good condition. The enginehouse forces should be so organized that the work reported to be done on a locomotive when it is received at the engine terminal, will not be slighted. A locomotive can be properly maintained only by following the work reports closely. The engineman is in better position to observe defects in a locomotive which interfere with its operation, than the inspector at the terminal, and his report should be given careful consideration. Too many times the engineman is prone to be too general in his reports, and an energetic campaign should be waged to impress upon their minds the importance of being specific in their reports.

The reports of the road foremen of engines should be watched with great care. These men, expert locomotive drivers, are able from their long experience to accurately diagnose the ailments of the locomotives. Their reports of defects should be given the weight they deserve and the repairs that they suggest should be made. The enginehouse has become the firing line of our transportation system; the locomotives, the guns. Unless they are able to shoot straight

and accurately, our transportation facilities will be crippled. There is no question but what the forces of many enginehouses should be enlarged, and unquestionably additional machine tools would be of great assistance. The enginehouse men are the ones that realize this better than anyone else and they should impress upon their superiors the necessity for reinforcements where they are needed. The condition of the locomotives at this time affects as never before the efficiency of our transportation system. They must be kept running and be made to do the full measure of their work. They cannot do this unless they are properly maintained.

Slackers in the Repair Forces

With the increase in pay for the workmen in almost every craft and the large opportunities for overtime on very nearly every railroad, the shop men are making more money than ever before. Some of them, forgetful, perhaps, of the importance of their work and of the need their country has for their services in the railroad shop, take advantage of these "good times" and give themselves too frequently a day or two "off." In fact the practice has become so general in some shops that it is necessary to send messengers to bring the men back to work. Whether these men realize it or not, they are slackers. The country, and particularly the railroads, need the active service of every man possible—and especially the craftsmen. If these men are earning so much money that they can afford frequent holidays, let them do the patriotic thing and buy Liberty bonds or save their money for the next loan which is sure to come.

We must all do our duty to our country if we are to win this war—and our duty is to do all the work in our particular line we can, and a little bit more. If worse comes to worse and the railways are unable to meet properly the demands for power and equipment there is a possibility of the Government taking over the railways and operating them as a military machine. This surely is not to be desired. The men must be made to realize how important a part they are playing in this struggle—their duty is as clearly defined as that of the soldier, sailor or marine. They must support by their labors the men who are taking life and death chances at the front.

Rolling Stock Situation in Germany

Because of the extreme shortage of material in Germany it has often been wondered just what the condition of the rolling stock is in that country. A small amount of information in regard to this is found in a letter published in the Railway Gazette of London, which was dated Berne, Switzerland, August 30. Particular attention is called to the lack of lubricants for both freight and passenger cars. It has been noticed in Switzerland that the journal boxes of the cars in which German iron and coal are sent are invariably empty. The Swiss federal railways, in accordance with their custom, fill these boxes and in this way Germany gets a little lubricating material.

Concerning the condition of the equipment, but little definite information has been obtained, but statements have been made in Switzerland to the effect that while about eight per cent of German cars and locomotives were ordinarily under repair, at the present time over 23 per cent is out of service for some reason or other. It is also stated that this percentage has materially increased since the time the information was obtained. The correspondent speaks of cast iron tubes being used in locomotive boilers, but undoubtedly iron tubes are meant, as it was the custom of the German railways to use bronze or copper tubes. Another interesting bit of information is that steel passenger cars, the floors and walls of which are covered with wood, are being built. The cars are longer than the wooden cars and it is said that the change is to be gradually effected on all German railway lines. It is further claimed that these steel cars are much lighter than the wooden ones because they require comparatively far less material in their construction. It would seem from this statement that these steel cars are being built in an effort to conserve the lumber supply rather than as in this country to provide a car which is materially stronger.

The financial condition of the railways is very well illustrated by the fact that surtaxes ranging from 10 to 16 per cent on fourth and first class passenger tickets respectively, are made with an extra charge for baggage of 12 per cent above the ordinary cost of its conveyance. Further than this, an additional charge of seven per cent has been made on the freight charges of all goods sent by rail, whether for short or long distances, and certain commodities must be sent by water wherever this is possible.

Arrangement of Car Repair Yards

The car is an important factor in the transportation problem at this time. The value of a car today is possibly higher than at any time in the history of the railroads of this country. The cars must not only be kept in repair, but they must be kept in action as much as possible. The manner in which car repairs are handled in the repair yards has a large bearing on the rapidity with which the repairs are made. To indiscriminately switch defective cars into the car repair yards will result in tying up a large amount of equipment because cars requiring light repairs may be pocketed between cars requiring heavy repairs. By placing the heavies on tracks by themselves and the cars requiring light repairs by themselves, less equipment will be tied up.

The cars to be repaired should be examined by the car foreman as they are brought to the yard and the switching crews should be made to spot the cars where the car foreman directs. The extra time taken in switching will be more than saved by getting the cars having the light repairs through the repair yard in a hurry, and back into service. It is also desirable to have an open end yard so that the damaged cars can be brought in from one end and passed out repaired, through the other end. It may be possible that a cross-over here and a switch there will greatly increase the output of a repair yard. The foremen in charge of these yards should give this matter careful attention and be ready with facts to show how and why their facilities should be improved. By doing this the congestion of the car yards may be reduced and the car supply will be increased.

Shop Efficiency and Illumination

Illumination considered in a field by itself has received but little consideration in the railway shop. More often the problem of artificial lighting has been met by the placing of a drop light here and there or by running an extension from a nearby socket to the place desired and hanging the lamp on some convenient or make-shift bracket requiring the workman to move it about to suit his particular needs. This is extremely undesirable both from the workman's standpoint and from the net cost for the lighting.

Poor lighting facilities materially interfere with the output of the workmen. Studies made of the effect of good lighting on shop production show that good light will add an average of approximately one-half an hour a day per man to the output which represents a production increase of five per cent, brought about by an expenditure of only one-half of one per cent of the wages; a saving equal to ten times the expense. The subject is of such importance that the Department of the Interior recently issued a technical paper on the relation between illumination and efficiency. The paper points out that actual instances have been reported where

production has been increased from two to ten per cent as a result of improved lighting.

Further than this, with a properly installed and adequate lighting arrangement the men will be more contented, the shop will be more easily supervised and the accidents will be reduced. When it is remembered that an accident not only deprives the shop of the services of the workman but also increases the actual operating expense due to the damage claims, the advantage of reducing the liability of accidents is evident.

With the installation of any system proper arrangements should be made for keeping the lights clean. There is nothing on railroads that depreciates so rapidly as does the efficiency of the lighting system. The rapid collection of dust and soot on a lighting fixture will easily cause the illumination to be reduced 50 per cent of its initial value in a short time. The standard of cleanliness for lamp reflectors should depend on a balance between the cost of cleaning and the loss by not cleaning. It has been shown that the loss on a 1,000-watt gas-filled lamp with porcelain enameled reflector will be approximately $34 if allowed to go without cleaning for a year. Figures available for an average shop show that it is possible to clean such reflectors for an average cost of $1 a month or $12 a year. It would obviously be poor engineering practice to put in more light than was necessary; therefore, it certainly is good practice to keep the reflectors clean so that the installation will give the illumination it was designed to give.

The War Performance of Cars and Locomotives

Interesting are the statistics showing the performance of cars and locomotives in this country since war was declared and the Railroads' War Board was organized in the early part of last April. With only 1.3 per cent more locomotives in service and only 2.3 per cent more freight cars than in July, 1916, railroads operating 220,054 miles of line in July, 1917, handled 20.2 per cent more ton miles of revenue freight. In other words, the 30,277 freight locomotives in service on the roads from which these statistics were obtained, handled in July the equivalent of 33,434,368,526 tons of revenue freight one mile, or an average of 1,104,283 ton miles for each locomotive, as compared with 930,455 in July, 1916, an increase of 18.7 per cent in the efficiency of each locomotive. The revenue ton miles per car for this particular month increased 17.5 per cent.

This was accomplished by increasing the number of tons of freight to each train from 617 to 681, or 10.4 per cent, and loading an average of 2.7 tons more, or 11.1 per cent, in each car, while the average mileage run by each locomotive per day was increased 4.4 miles or 6.8 per cent. The average mileage per car per day increased 1.9 or 7.2 per cent. While the percentage of empty car mileage was increased slightly, 3.9 per cent, the average number of cars in shop or awaiting shop was reduced 9.1 per cent and the average number of locomotives in shop or awaiting shop was reduced 8.7 per cent.

In the months of April, May, June and July, 1916, the average miles made per locomotive per day never exceeded 66 miles. In the same months of 1917 the average mileage per locomotive per day never was less than 68.8 miles, and in June it was 70.7 miles, and in May it was still more—71.3 miles.

These records show how well the railways, and particularly the mechanical department of the railways, have responded to the call of the country for transportation. The demands for cars and locomotives have been ably met but the end is not in sight. The winter with its snow and ice will be the real test. It is then that the locomotives, particularly, will prove their worth. Their steaming qualities must be carefully watched. Everything possible should be done now to improve them and prepare them for the winter before it is too late.

In other years it has been possible to go into the winter with a reserve of power. This year this cannot be done. It is not a question of how many extra locomotives will be available, but how can the power and the staying qualities of the present locomotives be increased to meet the more severe conditions and the constantly increasing demands. This is the real problem of the mechanical department men today.

NEW BOOKS

Effects of Storage Upon the Properties of Coal. By S. W. Parr. 44 pages, 6 in. by 9 in., illustrated, bound in paper. Published as Bulletin No. 97 by the Engineering Experiment Station, University of Illinois, Urbana, Ill.

A series of experiments, started in 1910, to determine the effects of storage upon the properties of bituminous coal has recently been completed by the engineering experiment station of the University of Illinois. The object has been to devise methods of storing which will avoid the risk of spontaneous combustion and to determine the extent to which coal deteriorates in storage. It is shown that, if properly sized and carefully handled, coal may be stored without danger of spontaneous combustion; that the actual loss of heat value, or deterioration, resulting from storage is slight; and that underwater storage eliminates entirely all risk of spontaneous combustion or of deterioration. The extent of the waste and economic loss incident to the present method of seasonal production, with its attendant abnormal demands upon transportation facilities is discussed, and it is estimated that the lack of storage facilities in large distributing centers necessitates a capital investment in mines and railroad cars of $500,000,000 in excess of the amount which would be required if production could be maintained at a uniform rate throughout the year.

Locomotive Handbook. Compiled by the American Locomotive Company. Bound in leather, 195 pages, 3½ in. by 6 in. Published by the American Locomotive Company, 30 Church street, New York. Price 75 cents.

The locomotive designer has always felt the need of a compact and concise source of information on the fundamentals of locomotive design for his ready reference. The American Locomotive Company has done much to supply this need in this Locomotive Handbook which has just been published. Heretofore the locomotive designer has been compelled to refer to material published in various places to get the information he desired on locomotive design, or else possibly to refer to rather cumbersome notes compiled by himself. The Locomotive Handbook will, therefore, fill a real need in the railway field.

At the beginning of this book is given a brief description of the American Locomotive Company. This corporation has a full working capacity of 3,000 locomotives per year and employs 20,000 men. This description is followed by formulae and tables giving the tractive effort of both simple and compound locomotives. The next subject considered is Train Resistance, the material being contributed by F. J. Cole, chief consulting engineer of the American Locomotive Company. It includes the resistance of freight and passenger cars of different weights and at different speeds, together with information showing how the results of tests check with the values given in the handbook. A comparison of the resistance of four and six wheel trucks is made and interesting information is included regarding the effect of a stop in increasing resistance. All phases of the subject are considered, such as velocity grades, acceleration, weather conditions, track resistance, etc.

Some eighteen pages are devoted to the subject of locomotive ratios, which is also written by Mr. Cole and is based

substantially on bulletin 1017 issued in January, 1914, by the American Locomotive Company. Illustrative examples are given to show how the information given under this head is to be used. Both saturated and superheated steam locomotives are considered. Following this is a section of about eight pages which gives the efficiency of longitudinal seams, stresses in staybolts and crown stays, method of bracing the back head and front tube sheet, the shearing stresses on rivets, etc.

Interesting information is also given on counterbalancing and fuel oil, the counterbalancing information being taken from the 1915 proceedings of the American Railway Master Mechanics' Association. Ten pages are devoted to the Interstate Commerce Commission's rules on locomotive machine and boiler inspection and testing.

The balance of the handbook contains methods used by the American Locomotive Company in the design of axles; crank pins, frames, piston rods, helical springs, elliptical springs, location of gage cocks for various grades over which the locomotive operates, piston thrust, etc. Information in tabular form is also given regarding the proper pressures for mounting wheels and piston rods. Several tables are included showing the effective area of staybolts, the proper location of tires on driving wheels, standard U. S. screw threads, properties of saturated and superheated steam, pipe threads, wire and sheet metal gages, moduli of rectangular and circular sections, decimal equivalents, speed-second table, tangent deflections, metric unit and U. S. equivalent tables, etc. Information is also given regarding valve setting and detailed instructions are included for setting the Walschaert valve gear.

Much time and a great deal of care has been exerted in the compilation of the information published in this book and it will be of considerable assistance to railroad men interested in locomotive design.

Locomotive Valves and Valve Gears. By Jacob H. Yoder, supervisor apprentices, Pennsylvania Railroad, and George B. Wharen, instructor mechanical engineering, University of Pennsylvania. 270 pages, 6 in. by 9 in., illustrated. Bound in cloth. Published by D. Van Nostrand Company, 25 Park Place, New York. Price, $3 net.

The purpose of the authors in the preparation of this volume has been to provide a treatise on valve gears to meet the requirements of railroad shop men who wish to acquaint themselves thoroughly with the operation of gears used in modern locomotive practice, and to fit themselves to master the intricacies of valve setting. The material has been compiled largely from notes used in the instruction of apprentices of the Pennsylvania Railroad and from knowledge gained by the authors in practical shop experience. Highly technical discussions of the principles of valve motion have been avoided.

The first chapter of the book is devoted to a description of the various types of locomotive valves, and following this the Stephenson and Walschaert valve gear are each dealt with in detail, the relation of the various parts and the effects of the inherent distortion of the motion upon the valve events being covered in a way which should readily be followed by the novice. The other valve gears used in locomotive practice, including the Baker, Southern and Young gears, are all described in a following chapter. The remainder of the text is given over to a detailed study of the effect on steam distribution of alterations in the valve and its events, and of locomotive valve setting.

The text is well illustrated throughout with diagrams and photographs and the book will be a valuable addition to the library of any ambitious mechanic. While not primarily a treatise on valve design, the book should prove of value to the designer and engineer engaged in locomotive work, as in it may be found a description of most of the devices which have been adapted to locomotive valve and valve gear practice.

COMMUNICATIONS

A PROTEST!—EDUCATE THE TRAINMEN

Eureka, Cal.

To the Editor:

When reading your editorial in the October issue on car maintenance, showing the necessity for doing the work in such workmanlike manner that the car would stay off the repair track, it occurred to me, as it has often occurred before on reading similar articles, how seldom the matter of the abuse of cars by trainmen and switchmen is touched on. In the present day movement of cars, and especially in the freight yards, it is one continual crash and bang. Half the time the trainmen are too indifferent to give signals. If the cars fail to couple on the first impact, a violent come-ahead signal is given which generally does the work.

Not all of the fault lies with the men by any means. Trainmasters have their arms in the air, as it were, crying, "Get over the road." It is understood, of course, by the tens of thousands of freight car maintainers all over the country, that the object of the transportation department is to keep down overtime in their department. This is a worthy object as we car men admit, but we suspect that it results in the trainman being extra destructive, a tendency he always has to a greater or lesser degree.

Everyone will admit that there never has been any construction which did not have its limit of endurance. This particularly applies to cars and especially to wood underframe cars, of which a large number are daily in service in competition with steel cars and steel underframe cars. Now I wish to state, in defense of the car repair force of the United States that we do not get a square deal from the transportation department. In its endeavor to save one hour of overtime for five men, it creates and fosters an already destructive spirit which costs the railroads of this country many times what it is endeavored to save. How in the name of "Sam Hill" can a car man in the ordinary course of his work on the rip track, put into the draft sills and the draft timbers of a wood underframe car more than was put into it by the designer when the car was first built. Oceans of cars are interchanging today that were built with short draft timbers reaching as far as the body bolster, with exceptionally poor end sills in addition, many of them being cut almost through to bring the coupler up to the proper height; and lots of them have deadwoods utterly inadequate to withstand the destructive handling the cars are given by the transportation department.

What can the repair man do about it? He can apply new draft timbers, a new end sill and probably piece out the center sills, knowing all the time that a train crew if a little hurried or slightly exasperated, can knock the whole thing to smash in one second. It is doubtless true that the car maintainers of the United States need touching up, but I claim, and I can bring several hundred thousand car men to back the assertion up, that the crying need is supervision of the trainmen. They should have some regard for the railroad's property, which may mean a slight increase in the time getting over the division, although I doubt it, and will undoubtedly save thousands upon thousands of dollars now spent in repairing cars that are hit just a few hundred tons harder than they were made to stand.

R. J. Quintrell,
Foreman Car Department.

Heavy Shipments of Peaches.—The New York State Peach Belt shipped this year 6,625 carloads of peaches, as compared with 4,459 cars last year, the best season on record.

FOREIGN MACHINE TOOL DEMANDS

Yearly Output of American Builders Tripled; Export Demands Expected to Continue After the War

THE demand for American machine tools at the present time and what it will be after the war was quite clearly shown in a series of addresses by representatives of foreign countries at the sixteenth annual convention of the National Machine Tool Builders' Association which was held in New York, October 30 and 31. The conditions indicate flattering possibilities for the builders and at the same time a prolonged demand for tools that can not be ignored by the purchasers of machine tools in this country. A large part of the export requirements after the war will be railway shop tools.

The demand for tools at the present time for the manufacture of munitions and for the upbuilding and maintenance of the various industries and railroads involved, directly or indirectly, in the great war machine is large, and will continue to be so while the war lasts. J. B. Doan of the American Tool Works Company and president of the association, stated in his opening address, that during the last three years there has been built about the same number of machine tools as would ordinarily be built in ten years. He said further regarding the war requirements that "any machine tool builder who does not bend all his mental energy to the solution of the problem of rapid output, is a lame soldier in the firing line. We must literally spend sleepless days and nights, for we are the 'machines behind the men behind the guns. No machines—no guns. The machine shops of this country are the real reserves of the army. Our country needs the service of the machine tool manufacturer now more than it ever has before. This terrific struggle means more than physical effort, it means strains of every kind, it means heavy taxes, it means personal sacrifices, it means work and lots of it."

In speaking of the future Mr. Doan called attention to the fact that on account of the present large production of machine tools there may arise the condition of an oversupplied market which, if it were found to exist, must be given careful consideration. Regarding the export trade, he said: "The machine tool builder must further improve his products, must grow more efficient and must deal with all nations in an open-minded, honest, straightforward way, which will permit us to extend our world trade to every country where a machine tool is used."

CONDITIONS IN ENGLAND

Henry Japp, C. B. E., deputy director general in the United States for the British Minister of Munitions, Production Department, spoke of the conditions in England. The following is an abstract of his remarks:

I am sure you gentlemen who manufacture machine tools must all realize the great responsibility that rests on your shoulders today, for without the machine tools of America the Allies could not have reached their present dominating position. This is a war of machinery, of the building up in three years of a machine to smash the war machine of Germany that was surreptitiously built up in the last forty years with malice aforethought to conquer the world.

The production of munitions, of course, depends almost solely on machine tools. The output in England is today twenty times what it was two years ago. There has been made in the cost of the manufacture of munitions for Great Britain during the last year, a saving of $200,000,000 over the costs of production for the previous year, and workmen have been so prosperous that out of their savings they have contributed $200,000,000 to the war funds. The employment of women in the manufacture of munitions and the dilution of labor with women, in the case of machine work, amounts to as high as 60 per cent, and these women have been able to earn, working piece-work, 90 per cent in excess of the time rate. They are employed in all manners of industries; viz., gage making, machining shells, foundry molding, glass blowing and shipbuilding, and, of course, agriculture. The maimed soldiers are being carefully equipped with artificial limbs and trained as skilled workmen.

Duration of War.—As to the possible duration of the war, I am no prophet, but each year the suggestion has gone out from Germany that the Germans cannot last another Winter. This is the same old effort to put the nations to sleep that was practiced for forty years while the Germans were preparing for the conflict. Make no mistake, let us not be deluded; the war, whether it ends this year or later, must be prosecuted as if it were to last for many years. Our combined effort must not relax or the good work already done will be lost. Germany is the nation that passed through the thirty years' war, so we know they have a great reserve of staying power and we must not be deluded by false predictions of early breakdown.

Conditions After the War.—If the British army is disbanded at the rate of 40,000 men per week it will require three years for the work, but as arrangements are perfected this work will no doubt be accelerated. Probably the same scale will apply to all the Allies.

Before the war we had not sufficient courage to spend $35,000,000 a year on welfare and betterment work, but today we spend that much per day for destruction, so that we will never again fear to invest our capital in pulling down and rebuilding the wretched hovels in which the poor of Europe are housed and in carrying on beneficent work.

There will be endless work to be done after the termination of the war in construction and reconstruction. The supplies required to reinstate the devastated industrial sections of France and Belgium, to say nothing of making up for the neglect in the up-keep of the British railway systems and other public utilities will surely keep the machine tool trade fully occupied for many years, especially as at present so much machinery is allowed to run without repair.

BELGIUM NEEDS RAILROAD SHOP TOOLS

E. G. Todd, of E. Isberque & Co., Antwerp, Belgium, discussed the machine tool situation in Belgium, an abstract of which follows:

Belgium has never been a country which has produced a great number of machine tools. Aside from a few shops which produced heavy lathes for railroad work, which were not of a modern design, and two or three lathe constructors, the country was devoid of machine tool builders. There are, however, a large number of shops which require machine tools. In the district of Liege alone there are 250 machine shops, including both the large and the small. During the idle period occasioned by the war the Belgians have re-arranged their plants so that they will become much more modern and better organized as soon as they can be re-equipped.

During the first two years of the war, certain factories in Belgium were fairly busy, but the German government have stopped the export of their products and have now stripped every plant in Belgium of all the machine tools they could find. There will, therefore, be a large number of tools to

be purchased to rehabilitate the plants, and contrary to general opinion, the Belgians will have funds with which to pay for the tools. Certain Belgian manufacturers are ready to put up the necessary cash for payment of the goods, and it may be of interest to add that all the gold which was held in the National Bank in Brussels has been saved, as well as the gold in a good many other banks and is now deposited in the Bank of England in London. A number of large Belgian firms have sister firms operating either in France or other countries, which will help to restore the plants in Belgium. Also the large profits made in the Belgian Congo during the war will be of assistance.

Before the war the largest exporters of machine tools into Belgium were Germany, then America, then England and Sweden in a minor degree. No doubt, the Germans will endeavor to find means of exporting their machine tools again to Belgium after the war, but the Belgians, however, will surely devise means to exclude these machines. The Germans specialize a good deal on railroad tools.

After the war, tools of all descriptions will be in great demand by the Belgians, particularly the labor saving machinery, as labor will be scarce. There are certain classes of tools which are possibly more in demand in the Belgian market than any other country and to which the American manufacturer has not yet devoted enough attention. These are the heavy railroad tools. There were no less than 19 railroad shops in Belgium before the war, which were producing locomotives for all parts of the world, and most of the tools required for the production of these machines were supplied by Germany, who made very costly and intricate tools which were not at all well received by the workmen. Some of the railroad tools required in Belgium are of a special nature as compared with the tools used in America. For example, in Belgium freight car wheels having cast steel centers with forged steel tires shrunk on are used. Tools which must be of heavy construction must be made to make these wheels. Strong attention is drawn to this fact as boring machines, axle lathes, slotting machines, wheel turning lathes, etc., for this heavy type of work will be in demand.

There should be a very promising future for American machine tools in Belgium after the war. A report has been published in which it is stated that the Belgian government estimates that $400,000,000 worth of tools, machinery and raw materials have been taken by Germany.

SOUTH AMERICAN SITUATION

G. E. Briggs, a representative of the National City Bank of New York at Buenos Ayres, Argentina, spoke of the export market in South America, saying in part as follows:

Germany realized the danger of abandoning the foreign markets to her competitors and prior to the struggle filled the custom houses of South America with merchandise evidently calculated to supply the demands of those countries for the duration of the war. Today, after three years of war, German products are still obtainable in South America. The grasp which Germany had on the South American trade was so strong that a large proportion of the merchants say frankly that they are waiting impatiently for the moment when they can resume their satisfactory trade with Germany.

Argentine.—While the Argentina is purely a cattle and agricultural country, there is a considerable importation of machine tools for use in the government and railroad shops. However, as 75 per cent of the railroad mileage of the Argentine is owned by English capital, 14 per cent by the state and 11 per cent by French companies, most of the supplies are purchased through London and Paris. Prior to the war 75 per cent of the machine tools imported, exclusive of those for the use of the English railroads, were of German manufacture. The Germans have adapted their machines to various uses such as in a lathe, by providing a deep gap in the bed which will accommodate work of 80 cm. in diameter, whereas a lathe of the same size without the gap would admit of work with a diameter of only 30 cm.

The majority of the American tools in the Argentine are in the shops of the English railroads and have been purchased by the London offices of those railroads from the English offices of the American manufacturers. Only a few American machines are in the government shops and still fewer are in the smaller industries.

Chile.—A favorable market exists in Chile. The principal users of machine tools are the government, and when I mention the government I include also the railroads, which are all state owned, and the mines. The government shops are largely equipped with American machine tools at the present time. A great establishment is now being built there by an American concern, to construct locomotives for the state roads. The Chilean government and Administration of Railroads usually buy their supplies through houses in Chile. Occasionally, however, at a time like the present, when they are encountering the greatest of difficulty in obtaining supplies, they send a commission to a European or to the American market. A commission of five or six young men has come from Chile to the United States to study the American railroad system. They intend to spend two years in this country, and it is expected that they will be the ones to dictate the Chilean railroad policy of the future.

OPPORTUNITIES IN RUSSIA

R. Poliakoff, assistant professor of mechanical technology, Technical Institute, Moscow, Russia, and a member of the Russian Purchasing Commission in the United States, spoke on Russia as a market for American machine tools. He said, in part, as follows:

Russia became acquainted with American machinery many years before the war broke out and has learned its value and has acknowledged its superiority as compared with similar products of other countries. In the last two or three years preceding the war, the importation of machinery to Russia amounted to approximately $4,000,000 to $5,000,000. Of this about $1,000,000 came from the United States, the same amount from England and the rest from Germany. While there cannot be the slightest doubt that in most cases the German machine tools were of inferior quality, they, however, served the purpose quite satisfactorily, supplying the ordinary user with a cheaper machine.

It is noteworthy that the types of German machinery were, so to say, inspired by the United States products and in many cases they were an imitation. As an example, a bolt and rivet forging machine of certain size, which is classified by the American manufacturer for making rivets up to 1 in. diameter, was copied by a German manufacturer who specified that it is capable of producing rivets up to 1¼ in. or even 1½ in. in diameter and so he was able to produce a machine which was considerably cheaper than the American machine of the 1½ in. capacity. If the machine became injured, the operator was held at fault. There is not the slightest doubt that the demand for machine tools in Russia after the war will be very great. All of the rehabilitation of the region, the devastation of which was so thoroughly attended to by the Germans, will have to be carried out as quickly as possible when peace permits. Whatever conditions exist now in Russia, which are not as hopelessly bad as they are pictured by some sensation seeking newspapers, the country is undergoing a process of regeneration and reconstruction which will require machine tools. Machine tools are helping and will help us to win the war; machine tools will help us after the war, when we shall want them perhaps even more than now to improve our living conditions.

There is not the slightest doubt that Russia can be a good market for American machine tools after the war, and in order to avail themselves of this market the American

manufacturers will have to be interested in it and see that they are properly represented by reliable parties.

FRANCE A HEAVY IMPORTER OF TOOLS

Roger P. Redier spoke on the machine tool situation in France. An abstract of his remarks follows:

Approximate figures of import of machine tools to France by America, Germany and England, the three principal importers, for a period of five years before the war show a yearly average of $2,283,000. The imports of machines from America alone to France for the last three years amount to $50,126,807, or $16,708,935 yearly. These figures at first sight are enormous, but if it is considered that the machines have been run to their utmost capacity and 24 hours a day with only the most urgent repairs being given them, the above sum should be divided by three to give a more comparative figure.

The fact that French manufacturers are very conservative and do not scrap machines, but repair them and use them over again, does not present a very favorable outlook for after the war business. However, the condition of France after the war will be such that there will be a large demand for labor saving machinery, and France will be an altogether different nation industrially. The industries that will have to be rehabilitated and the new industries that will develop will require the aid of America and of American machinery. France will have to rebuild and re-equip her destroyed factories, rebuild her rolling stock and her merchant marine. All this will demand machine tools.

After the war there will be two classes of machine tool buyers, the ones that have been engaged since the beginning of the war in manufacturing war materials and the others, less fortunate, whose factories have been destroyed or closed during the struggle. The first, although they will require machine tools of certain type to stabilize their regular manufacture, will not be for a little while what we call heavy buyers. The other class will require the most attention and there is no doubt that in order to re-start their business they will require easy terms of payment.

There are good reasons to believe that the machines purchased by the American government for export to France for military purposes will never come back and will be sold on the spot after the war, which might create at that time a little disturbance in the market.

RAPID DEVELOPMENT IN SPAIN

Henry S. Moos, of the American Machinery Syndicate of New York and Spain, spoke on the machine tool situation in Spain. He spoke, in part, as follows:

Industrial life in Spain has now reached a degree of activity never known before, and that country is beginning to take a more prominent position in the world's market of machine tools than heretofore.

At the beginning of 1916 Spain possessed 8,700 miles of railroad track and heavier locomotives have now been acquired. A prominent industry in Spain is the railway and tramway car building industry. There are five factories in Spain, two of which are very important. The largest plant is located near the French frontier and is manufacturing its own axles, tires and wheels and is turning out thousands of railroad cars per year. A new corporation has just been formed for the manufacture of railroad equipment, cars, tires, locomotives, forgings, etc., and one of the engineers of this concern is at the present time in the United States studying conditions with a view of purchasing several hundred thousand dollars' worth of machinery.

In view of the difficulties which a number of Spanish manufacturers have experienced in securing machine tools during the period of 1914 to 1915 from the United States, an entirely new industry has been created in Spain. Before the war practically no machine tools were produced there. Today, there are at least 20 firms, some of them employing as many as 500 and more men engaged in the manufacture of a wide range of machine tools, principally upright and sensitive drilling machines, screw cutting lathes, engine lathes, planers, shapers, etc. New factories are sprouting up like mushrooms and the continuous development of Spanish industrial life must necessarily create an ever growing demand for new and additional equipment to keep and start industries going. The opportunity for American manufacturers to obtain a lasting foothold in Spain is greater now than it ever has been. The number of machine tools shipped to Spain in the last three years from this country alone, is probably larger than the sum total of such machinery shipped into that territory during the 20 preceding years.

WORD FROM OUR RAILWAY MEN IN FRANCE

An interesting letter from Charles Gibson Brown, Jr.,* who recently went to France with the railway regiment as lieutenant in Company E, 19th Regiment, U. S. Engineers, gives an excellent idea of what our boys are doing over there. He writes as follows, his letter having been abstracted somewhat:

"Today we started work. Owing to delays in shipment of overalls, tools and all manner of equipment, we had a busy two weeks' work getting set, but with a hundred and one typically French delays, we got off. We have taken over parts of the Paris-Orleans shops. They do not compare with those in Altoona, but they are bigger than the average Pennsylvania shops, except those at Philadelphia and Trenton, and have many American tools. The engines range from those much smaller and older than any we have to those as big as our regular freight engines or even a bit larger. Our men started in on a bit of an engine, built in 1885 in Alsace Lorraine, and now in yard service. Starting at 6:30 a. m. with one and one-half hours out for dinner, they had the engine completely dismantled by 5 p. m., ready to start repairs. The French have been in the custom of taking three or four days to get this far, from what I understand. When our men get accustomed to the work and the new system of measurements, they will do still better.

"I get up at 5 a. m. and walk to the shop. I could write for an hour on shop conditions and the many strange peoples working in them, including French women who do all kinds of work. After having been away from shop work for over four months, the clang of the boiler shop was like music. For the most part, things are much like the equipment in the American shops. The French go at the work in much the same general way, but in a much slower and more painstaking manner than we do at home. We find quite a few machines built in the United States and a number of German make. I am general foreman of the erecting and machine shops. This work covers that part of my special apprenticeship. I have 120 men under me.

"When this reaches you I will have finished my fifth month in uniform, and have not had a single regret over going into the service. Together with the other officers stationed here, I made a little trip to the country. It is a fine country; full of remains from ancient and near ancient history. The houses are built into the cliffs and we saw old city walls, ruined castles and so on.

"In any boxes you send, put in magazines, especially those full of pictures. They are most liked. The men will appreciate the Christmas box you speak of sending. Have met Captain Walker, formerly of State College. It was a sight for sore eyes to see him in the dining room when we came in for dinner."

* Mr. Brown is a 1916 graduate of the Pennsylvania State College.

RAILWAY REGIMENTS' TOBACCO FUND

Recent despatches from France have told of the splendid work being done by the nine regiments of American railway men who are now operating an important French strategic railroad. The service which they are rendering is highly important and while they do not take part in the fighting they are exposed to all the dangers of warfare. These men enjoy the distinction of being the first American soldiers to be actually under fire in the war zone in France.

As a means of showing their appreciation of what the members of the railway regiments are doing for their country, a movement has been started by persons connected with the railway supply industry to raise a "Railway Regiments' Tobacco Fund." The committee in charge of the fund is made up of F. A. Poor, president of the P. & M. Company, chairman; Samuel O. Dunn, editor of the Railway Age Gazette, secretary; E. H. Bell, president of the Railroad Supply Company and president of the National Railway Appliances Association; George A. Post, president of the Standard Coupler Company and president of the Railway Business Association; R. P. Lamont, president of the American Steel Foundries; J. M. Hopkins, president of the Camel Company; and A. C. Moore, vice-president of the Safety Car Heating & Lighting Company. John R. Washburn vice-president of the Continental and Commercial National Bank of Chicago, will act as treasurer of the fund.

The movement has the hearty endorsement of Samuel M. Felton, president of the Chicago Great Western and director-general of the military railways of the United States. It is hardly necessary to say that smoking is one of the principal means of enjoyment of the soldiers. Deprived of their usual comforts the solace which tobacco affords is almost a necessity. Anyone accustomed to American tobacco can derive little pleasure from that which is sold in France and for that reason it is necessary to send tobacco from this country, and since it is difficult to secure the delivery of shipments in bulk it must be forwarded by parcel post. Mr. Felton estimates that each of the nine railway regiments now in service will require 20 packages of tobacco of 15 pounds each, with the necessary cigarette papers, and five pounds of pipe tobacco weekly. This would make a total for the nine regiments of 2,160 pounds, which would cost approximately $1,080 per week.

A circular letter is now being sent to railway supply concerns requesting them to subscribe $10 a month for fifteen months from October 1, 1917, to January 1, 1919, this subscription to be terminated at an earlier date should the war end before the expiration of that period.

It is hoped in this way to raise an amount sufficient to provide "smokes" for all the members of the existing nine railway regiments.

Up to October 30 subscriptions had been received from the following companies:

Ajax Forge Company, Chicago, Ill.	(to cover 15 months)	$150
Ajax Rail Anchor Co., Chicago		10 a month
American Flexible Bolt Co., Pittsburgh, Pa.		10 a month
American Manganese Steel Co., Chicago Heights, Ill.		10 a month
American Steel Foundries, Chicago		10 a month
Bronze Metal Co., New York, N. Y.		10 a month
Buckeye Steel Castings Co., Columbus, Ohio		10 a month
Bucyrus Co., South Milwaukee, Wis.		10 a month
Buda Company, The, Chicago	(to cover 3 months)	30
Camel Co., Chicago, Ill.		10 a month
Dilworth, Porter & Co., Pittsburgh, Pa.		10 a month
Economy Devices Co., New York, N. Y.		10 a month
Haskell & Barker Car Co., Chicago, Ill.		10 a month
Imperial Appliance Co., Chicago		10 a month
Independent Pneumatic Tool Co.		10 a month
Interstate Iron & Steel Co., Chicago		10 a month
MacRae's Blue Book, Chicago		10 a month
Madden Co., Chicago, Ill.		10 a month
Morden Frog & Crossing Works, Chicago	(to cover 3 months)	30
More-Jones Brass & Metal Co., St. Louis, Mo.		10 a month
Mudge & Co., Chicago		10 a month
Ohio Injector Co., Chicago		10 a month
Okonite Co., New York		10 a month
Paxton-Mitchell Co., Omaha, Neb.		10 a month
Pennsylvania Tank Car Co., Sharon, Pa.		10 a month
Poole Brothers, Chicago		10 a month
Prendergast Co., Marion, Ohio		10 a month
Pyle-National Co., Chicago, Ill.		10 a month
P. & M. Co., Chicago, Ill.		10 a month
Q & C Co., New York		10 a month
Railroad Supply Co., Chicago, Ill.		10 a month
Railway Age Gazette, New York, N. Y.		10 a month
Railway Review, Chicago, Ill.		10 a month
Railway Steel-Spring Co., Chicago		10 a month
Roberts & Schaefer Co., Chicago	(to cover 15 months)	150
Ryan Car Co., Chicago, Ill.		10 a month
Safety Car Heating & Lighting Co., New York, N. Y.		10 a month
Sargent Co., Chicago, Ill.		10 a month
Sellers & Co., Wm., Philadelphia, Pa.		10 a month
Sherburne & Co., Boston, Mass.		10 a month
Spencer Otis & Co., Chicago		10 a month
Standard Coupler Co., New York, N. Y.		10 a month
Standard Forgings Co., Chicago, Ill.		10 a month
Standard Steel Car Co., Chicago, Ill.		10 a month
Valentine & Co., New York		10 a month
Vapor Car Heating Co., Chicago		10 a month
Whiting Foundry Equipment Co., Harvey, Ill.		10 a month

Checks should be made payable to "John R. Washburn, treasurer," and forwarded to "Samuel O. Dunn, secretary, Railway Regiments' Tobacco Fund, Transportation Building, Chicago."

A MESSAGE FROM THE TRAVELING ENGINEERS

At a meeting of the executive committee of the Traveling Engineers Association, B. J. Feeny of the Illinois Central and president of the association, addressed the members pointing out the duty of the traveling engineers in this world war, saying in part as follows:

"It is well for us to remember that the railways are going to have their hands full to give the necessary service. As employees we are asked to give the best of our talent and energy, as well as suggestions for bettering conditions that come to our attention. The Nation wants our co-operation. Let us all be Americans—both in fact and name.

"While much has been done by the members of this association, I wish to remind you what can be done in the way of greater assistance to the Council of National Defense. The conservation of fuel is one of the most serious problems confronting the Government and the railways today. Many railways have already organized departments for supervising the handling and performance of locomotives. With the cost of fuel as great as it is now, the most rigid economy should be practiced and to this end enginemen must be thoroughly trained—they must be shown how to get the most out of every pound of fuel fired. The only way to do this is by supervision. It will therefore be necessary for the traveling engineer to give the closest attention to firing methods and inspection of idle engines under steam, with a view of reducing to a minimum the consumption of coal. It is of great importance that locomotives be loaded to their full capacity. This not only helps to relieve the congestion, but more work will be obtained from available power.

"The modernizing of old locomotives will require a great deal more attention with a view to bringing them up to maximum efficiency. In modernizing old locomotives we must equip them to take the place of new ones that cannot be built in time. We are now in position where all locomotives and all men must do more than ever.

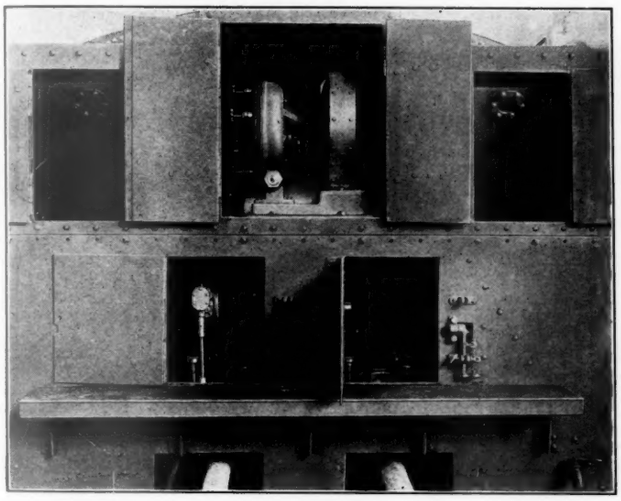
"The traveling engineer, from his past experience as a locomotive engineer, can prove very valuable to the railways in co-operating with the operating department. It is therefore up to us to take counsel together and see if we cannot help reduce the cost of fuel and make more perfect the transportation chain."

Action was taken by the executive committee on both this and next year's work. It was decided to publish the reports of the committees who have prepared them for the annual meeting which should have been held in September but was postponed on account of war conditions. New subjects were selected for consideration by the association for next year. A committee was appointed to offer their services to President Willard, Chairman of the Railroad Department of the National Board of Defense. The next meeting will be held September 10, 1918, at Chicago.

USE OF PULVERIZED COAL IN BRAZIL

This Method of Burning Coal Has Made Available Quantities of Brazilian Fuel for Railroad Purposes

AS much as the railroads and industries in this country are suffering from the present fuel situation, the problem is insignificant when compared with that of Brazil. With about 500,000 square miles of territory containing deposits of coal which can be easily mined and transported to the industrial centers, Brazil has been forced



View of the Front End of the Tender Showing the Distributing Machinery

to import this material from Europe and America because of the fact that up to the present time it has been found impossible to burn the domestic coal successfully. In 1915 there was imported 1,346,147 metric tons, 561,150 of which came from America. The price of this coal has more than doubled on account of the war, the average price now paid being about $40 per ton. Even at this high rate Brazil has been unable to obtain more than 75 per cent of its requirements.

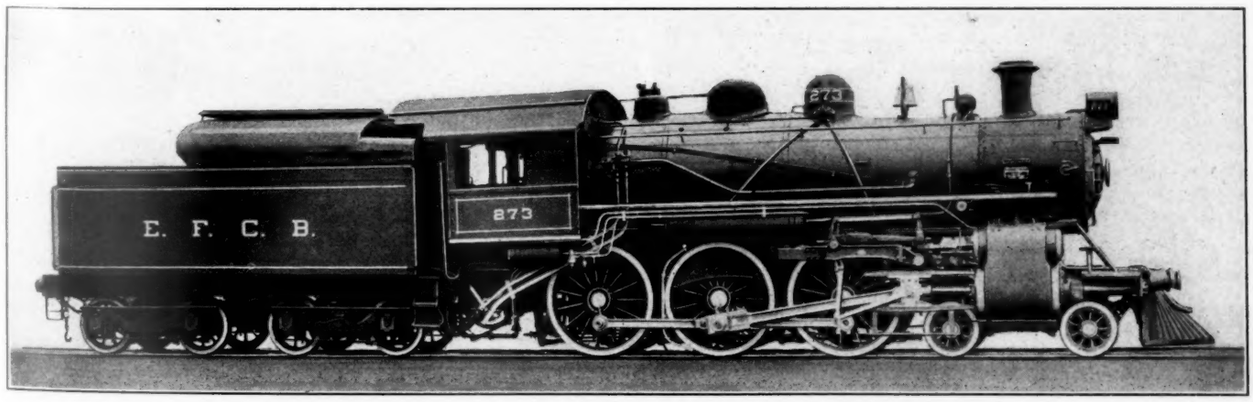
The difficulties encountered with the use of Brazilian coal are due to the large amount of sulphur and iron pyrites contained in it, which combined with the ash forms such a large amount of clinker that efficient combustion on ordinary grates is impossible. The analysis of the coal is as follows:

Moisture	from 2 to 8 per cent
Sulphur	from 3 to 9 per cent
Volatile	from 14 to 28 per cent
Fixed carbon	from 34 to 58 per cent
Ash	from 26 to 30 per cent

The relatively high volatile and carbon content make it very desirable for fuel if it can be burned successfully.

The Brazilian fuel situation is of national importance and has a direct bearing on the political situation. Several extensive and expensive investigations have been made to find a means for successfully using this fuel, but until 1915 the problem remained unsolved. At that time an article appearing in the Railway Age Gazette describing tests made by the Locomotive Pulverized Fuel Company of New York, with pulverized coal on locomotives, was called to the attention of the government by the director of the Central Railway of Brazil, Dr. Miguel Arrojade Lisboa. This method of burning fuel not having previously been considered in connection with the Brazilian coal, Dr. Joaquim de Assis Ribeiro, chief of traction of the Central Railroad of Brazil, was sent to this country to make an investigation. The possibilities of this method were so apparent that 50 tons of Brazilian coal was shipped to this country for tests on the pulverized fuel burning locomotives. These tests proved so satisfactory that in May, 1916, Dr. J. J. da Silva Freire, sub-director and locomotive superintendent of the Central Railway of Brazil, came to this country for further investigation, paying particular attention to the method of using pulverized fuel in both locomotives and stationary boilers.

As a result of the second investigation the Central Railway of Brazil decided to install a pulverized fuel preparing plant, having a capacity of 15 tons per hour, to be used for steam locomotives and stationary boiler equipment at shops located at Barra do Pirahy, which is about 65 miles north of Rio de Janeiro. The plans and specifications for this equipment were prepared by the International Pulverized Fuel Corporation, the foreign agents of the Locomotive Pulverized Fuel Company under whose direction the Brazilian pulverized coal tests were made. At the same time an order was placed for twelve 10-wheel passenger locomotives to be equipped with that company's pulverized fuel burning



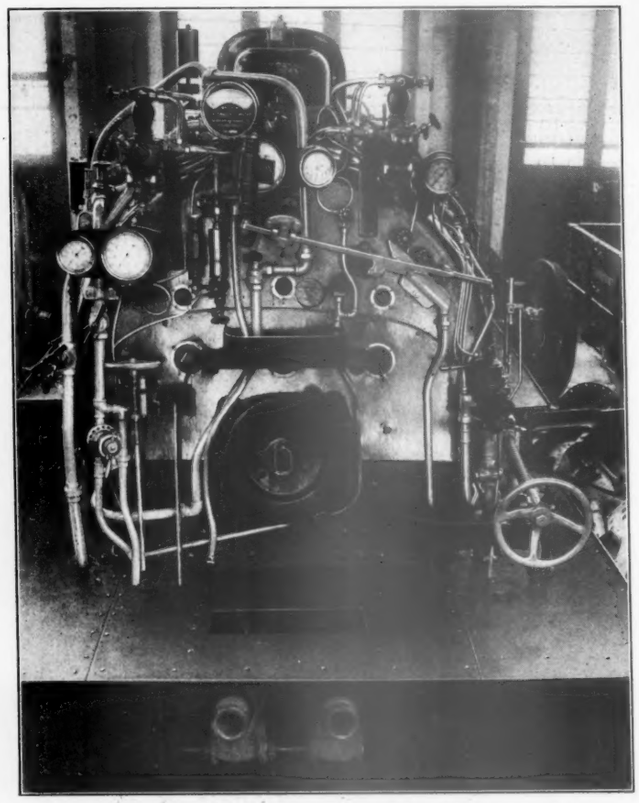
Pulverized Coal Burning Locomotive for the Central Railway of Brazil

apparatus. These locomotives were built by the American Locomotive Company.

The ground was broken for the pulverizing plant May 17, 1917, and the plant was placed in operation August 22. The first locomotive fired with pulverized fuel was put into service August 27 and the rest of the locomotives were put into commission at the rate of one a day thereafter. On September 9 the first run was made with the pulverized National coal. This run was made with considerable ceremony, the president of the republic riding the locomotive throughout the trip. A report of the trip from an observer is given below:

"The first official experience with our national coal pulverized was realized yesterday, September 9, on the Central Railway of Brazil, with the special train that transported Dr. Wencenslao Braz, president of the Republic of Brazil, and his staff. Locomotive 282 was attached to the president's special train at Barra do Pirahy and pulled it to Cruzeiro, a distance of 147 kilometers, or about 90 miles, the time being three hours. The trip was made with excellent results, particularly in the long stretch between Barra do Pirahy and Cruzeiro.

"During a great part of the trip the president remained

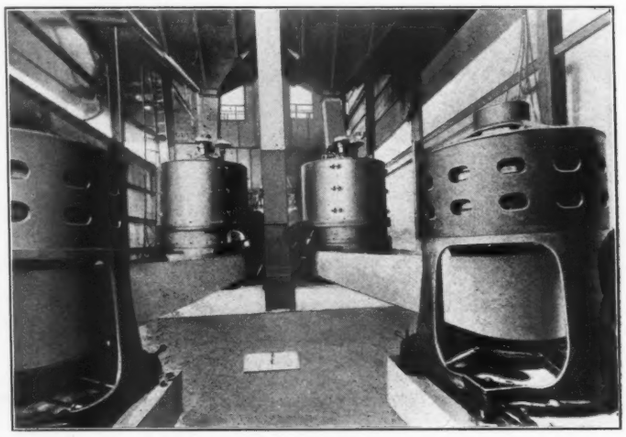


Back Head of the Pulverized Fuel Burning Locomotive with the Cab Removed

in the locomotive cab, assisting with the feeding of the firebox with the national coal pulverized in the plant recently constructed at Barra do Pirahy, the coal having come from the Sao Jeronymo mine. The president of the republic showed himself very much impressed with the calorific value of the coal and the ease and regularity with which steam pressure was maintained by the locomotive throughout the trip, and without any smoke.

"The tonnage of the train was 210, which was hauled back, the total coal used being, as well as I can estimate, about 4 tons. The running time going was three hours exactly; the return 3 hours and 25 minutes. President Braz sent a telegram to the minister of public works, as follows: 'The fuel problems of our country have been solved.' He also sent a telegram of congratulations to Dr. Assis Ribeiro. The President and the director expressed themselves as being entirely satisfied and highly pleased at the demonstration, and also as to the simplicity of the machinery and control over the fire, which was thoroughly demonstrated while they were on the locomotive.

"On leaving the locomotive cab for his car, the President embraced effusively the engineer and fireman, and congratu-



Interior of the Pulverizing Mill

lated Dr. Aguiar Mareira, director of the Central Railway of Brazil, on the results obtained."

At the conclusion of the trip the president sent the following telegram to Dr. Traveres de Lyra, minister of railways:

"From Barra do Pirahy to Vargem Alegre I traveled on 10-wheel locomotive No. 282 fitted for the use of pulverized fuel, with excellent results. The trip was made with a velocity of 65 kilometers per hour, having a train of 210 units behind it. I take great pleasure to give you this communication, which I am certain will be received by all Brazilians interested as a solution of one of our most important national problems. Salutation.—*Wencenslao Braz.*"

With the successful use of native coal, Brazil has solved one of its most perplexing economic problems. The Brazilian government has contracted to equip 250 of the locomotive on the Central of Brazil with the pulverized fuel burning equipment during the next five years. This contract also includes the equipping of stationary boilers and industrial furnaces.

The 12 locomotives which were built in this country and sent to Brazil equipped to burn powdered fuel weigh 172,000 lb. and have a maximum tractive effort of 28,300 lb. They have a gage of 5 ft. 3 in., cylinders 21½ in. by 28 in., driving wheels 68 in. and weigh 122,000 lb. on drivers. They are equipped with firebrick arches and superheaters, have a total heating surface of 2,149.7 sq. ft. and a superheater heating surface of 428.2 sq. ft.

The illustrations show a view of the locomotive, a view of the back head of the locomotive with the cab removed, the front end of the tender containing the pulverized fuel distributing machinery and interesting views of the pulverizing plant.

Federal Postal Profits.—The Post Office Department announces that the profits of the department for the fiscal year ending on June 30 last amounted to more than $9,000,000; and that sum has been paid in to the Treasury Department as a contribution to the general fund.

CONVERTED SWITCH LOCOMOTIVES

Obsolete Twelve-Wheel Freight Locomotives Adapted To Switching Service by Altering the Frames

BY W. H. HAUSER
Mechanical Engineer, Chicago & Eastern Illinois

THE Chicago & Eastern Illinois has an engine class containing 16 12-wheel freight engines which were built in 1897 and 1899. When these engines were placed in service they were among the largest hauling freight. The size of freight equipment has increased so greatly, however, that for some time past these 12-wheelers have been relegated more and more to odds and ends of service, with their obsolescent day fast approaching. More recently they frequently have been used in a sort of semi-switching and road service but not with entire success due to their long rigid wheel base. They are well built engines, however, except for the type of fire-box, which is of the O-G type very narrow and 10 ft. 6 in. long.

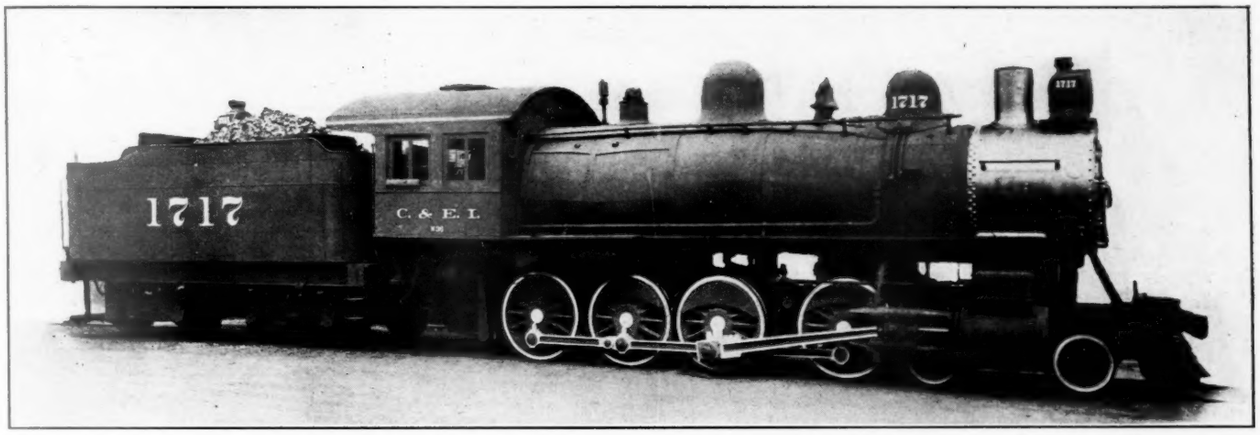


Fig. 1—The Twelve-Wheel Locomotive Before Conversion

On account of growing need of switch power it was proposed to change some of these 12-wheelers to 6-wheel switchers. The idea of converting freight engines with four pair of drivers and an engine truck to 6-wheel switchers is not a new one as it has been practised by other roads where the engines were so designed that the change could be made simply by removing the engine truck and the rear pair of drivers. In the case of our 12-wheelers, however, this conversion had never been considered as the engines were not designed to permit proper weight distribution if this simple plan of conversion were followed. It was found necessary to change the wheel spacing in order that the proper wheel loads might be obtained.

Figs. 1 and 2 show one of these engines before and after conversion. It will be noticed that the converted 6-wheel switcher is in general a better looking engine than the original 12-wheeler. Many of the characteristics of the engines are similar as is to be expected, but some of the more important are quite dissimilar as will be noted below:

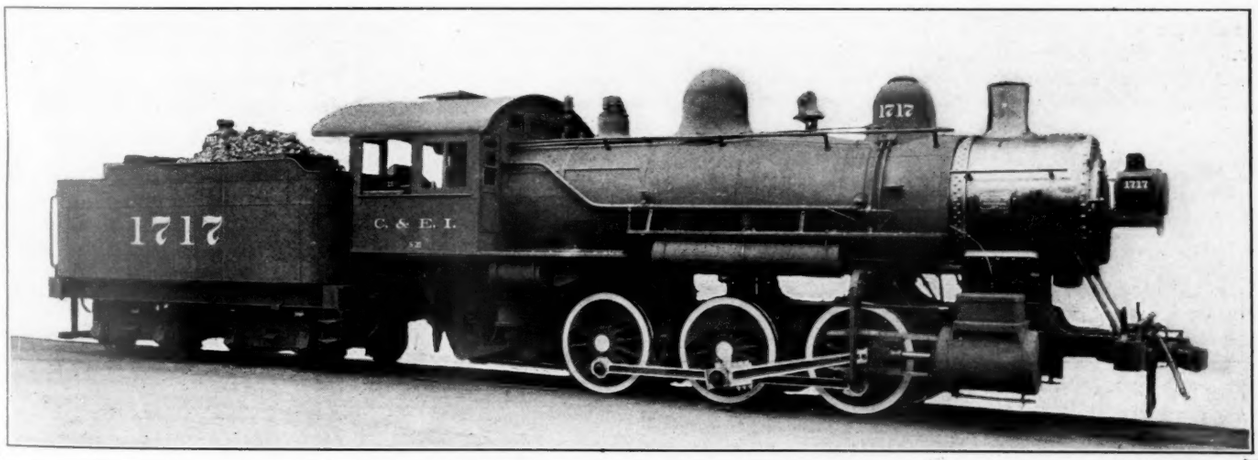


Fig. 2—The Six-Wheel Switcher After Conversion

	Before conversion, 12 wheeler	After conversion, 6 wheel switch
Service	Freight	Switch
Tractive effort	35,400 lb.	35,400 lb.
Weight in working order	175,500 lb.	160,660 lb.
Weight on drivers	144,050 lb.	160,660 lb.
Weight on leading truck	35,050 lb.	.....
Weight of engine and tender in working order	292,300 lb.	263,160 lb.

	Before conversion, 12 wheeler	After conversion, 6 wheel switch
Wheel base, driving	15 ft. 6 in.	12 ft.
Wheel base, total	25 ft. 4 in.	12 ft.
Wheel base, engine and tender	54 ft. 7 in.	45 ft. 2 in.
Weight on drivers ÷ tractive effort	3.96	4.53
Simple cylinders, diameter and stroke	21 in. by 26 in.	21 in. by 26 in.
Driver wheel diameter	55 in.	55 in.
Boiler, style firebox	O-G	O-G
Boiler, working pressure	200 lb.	200 lb.
Firebox, length and width	126 in. by 41 in.	126 in. by 41 in.
Flues, number and outside diameter	288—2 in.	288—2 in.
Heating surface, flues	2,045 sq. ft.	2,045 sq .ft.
Heating surface, firebox	197 sq. ft.	197 sq. ft.
Heating surface, total	2,242 sq. ft.	2,242 sq. ft.
Grate, length and width	126 in. by 41 in.	94 in. by 41 in.
Grate area	35.8 sq. ft.	26.8 sq. ft.
Tender, weight light	42,500 lb.	41,000 lb.
Tender capacity, water and coal	6,000 gal.—13 tons	5,000 gal.—10 tons

In converting the locomotives data covering actual or computed weights were collected for the entire engine and its various parts. A center of weight was found and the driver spacing was then sketched preparatory to a complete consideration of the work necessary for conversion. As a result of these computations it was found that by lengthening the distance between the second and third drivers by 17 in. and by shortening the distance between the first driver and the center line of the cylinder by 17 in. that the weight on all three pair of drivers would be very evenly divided—in fact, more evenly than is frequently the case with newly built six-wheel switchers. Below is shown a table of these weight distributions:

	Twelve wheeler, before conversion	Six wheeler, after conversion
Engine truck	35,050 lb.	.....
First pair drivers	35,050 lb.	50,900 lb.
Second pair drivers	35,050 lb.	57,800 lb.
Third pair drivers	35,250 lb.	52,000 lb.
Fourth pair drivers	35,100 lb.	.....

Fig. 3 shows the frame of the 12-wheelers before conversion and Fig. 4 shows the frame as redesigned with the even distribution of weight over three pair of drivers.

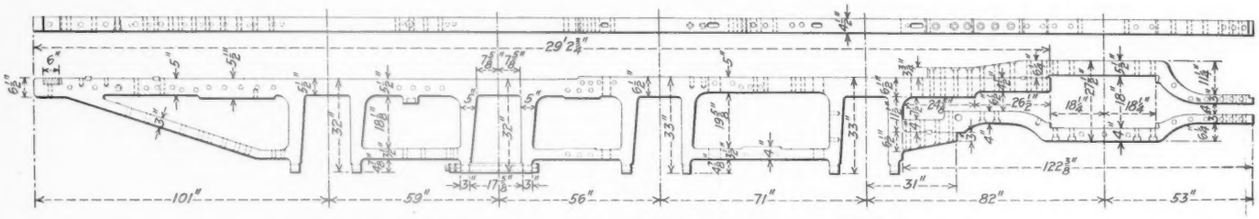


Fig. 3—The Frames of the Twelve-Wheel Locomotive Before Conversion

The method followed in changing the frame was quite novel and interesting. The upper and lower front frames were removed and delivered to the blacksmith shop. Six holes were plugged and welded in the blacksmith shop in the rear end of both top frames in order to match with the holes in the top front tongue of the main frame, while the

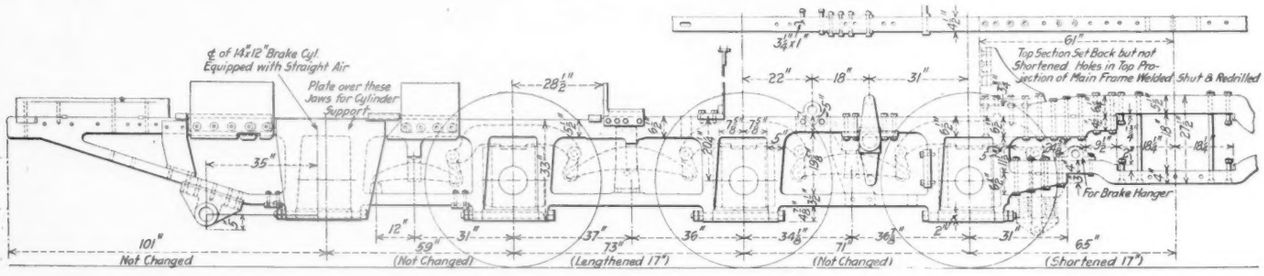

℄ of 14"x12" Brake Cyl Equipped with Straight Air
Plate over these Jaws for Cylinder Support
Top Section Set Back but not Shortened Holes in Top Projection of Main Frame Welded Shut & Redrilled
For Brake Hanger
101" Not Changed
(Not Changed)
(Lengthened 17")
(Not Changed)
(Shortened 17")

Fig. 4—The Finished Frame for the Six-Wheel Switch Locomotive

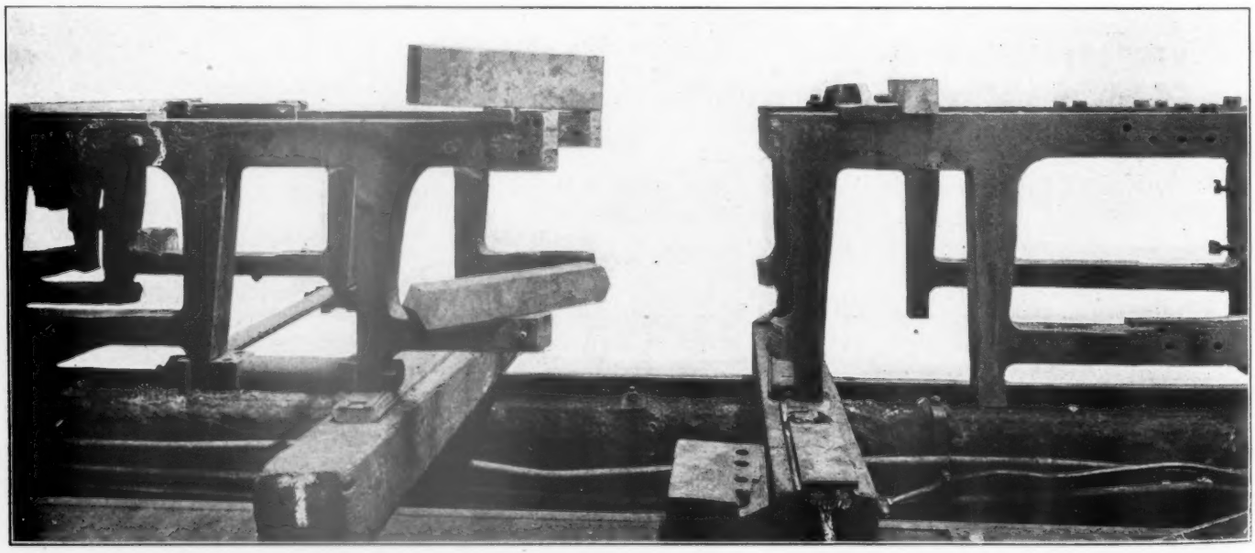


Fig. 5—The Frames Ready for Welding In the Additional Material Between the Second and Third Drivers

rear end of the lower front frame was straightened and cut off to fit as shown. The main frames were cut with the Oxweld torch between the second and third drivers and separated and 17 in. of each of the front upper main frame tongues were cut off by the same means.

Fig. 5 shows how the frames looked after the blacksmith and machine work had been completed and they were ready for welding in the 17-in. pieces between the second and third drivers. These pieces were welded in with the Oxweld torch. The finished job had a neat appearance. Cost figures covering Oxweld method of cutting and welding this frame as compared with taking down the entire frame and welding it by the blacksmith fire method are as follows:

Cut and weld with Oxweld	Taken down, cut, weld and replace by Blacksmith Fire Method
$117	$386

There are other minor items in connection with the change in the design of the locomotives such as a new and heavier guide yoke brace and a new cast steel guide yoke. The main rods were shortened 17 in., while the side rods between the second and third drivers were lengthened 17 in. The spring rigging had to be altered but to offset this was the salvaged old springs and the fact that repairs and renewals would have been necessary with the old spring rigging anyway. When the first engine was placed in service it was found that owing to the size of the firebox the firing had to be watched with the greatest care, in fact too closely to permit of good economical operation. The engines had always been free steamers in freight service when properly fired and now when placed in switch service they became too erratic. After a few trials this trouble was overcome by disconnecting and laying firebrick over three of the front grates and building a wall 27 in. high at the rear end of these brick. Since, five converted engines have operated with great success and the others are to be converted as conditions permit.

The total cost of the extra work attendent on converting a single engine and over and above the general repairs and credits obtained for material removed was approximately $450. The converted engines have been very successful in service both from a mechanical and operating standpoint.

PREVENTION OF LOCOMOTIVE SMOKE*

The Effect the Brick Arch Has on Smoke and the Reasons Why Sufficient Firebox Volume is Necessary

BY J. T. ANTHONY†

IN the 1913 proceedings of the Master Mechanics' Association a report was made in which it was stated that a 50 per cent reduction in smoke was obtained by the use of the brick arch. The tests from which this information was obtained were made with Penn gas coal, having

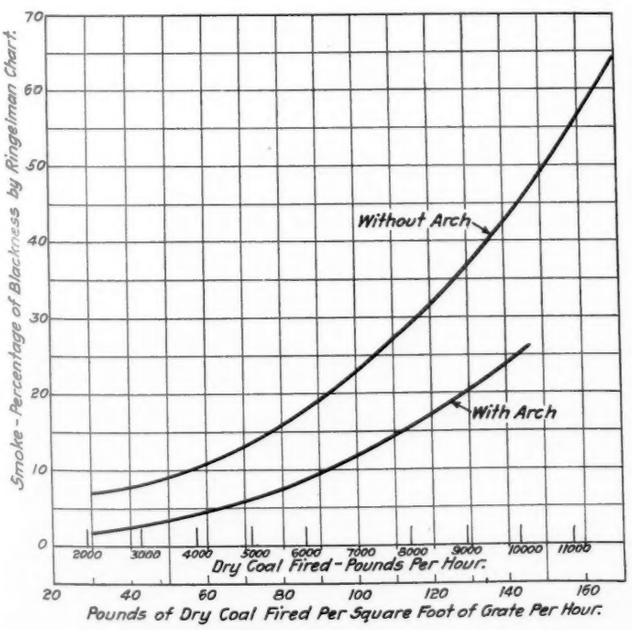


Fig. 1—Smoke Intensity Reduced by the Brick Arch

34.07 per cent volatile matter. Together with this reduction in smoke there was an increase in evaporation of 8.6 per cent due to the arch.

Later the Chicago Smoke Commission, of which W. F. M. Goss, formerly dean of the railroad department of the University of Illinois, was chief engineer, found that the brick arch decreases the average density of visible smoke by 33 per cent; decreases the total average quantity of cinders and fuel dust emitted in smoke by 25 per cent; decreases the amount of carbon contained in cinders and fuel dust per ton of coal consumed 24 per cent; decreases the amount of ash contained in cinders and fuel dust per ton of coal consumed 28 per cent; decreases the volume of air intermingled with gases of combustion discharged through the stack 15 per cent; increases the volume of CO_2 discharged through the stack 6 per cent; decreases the volume of CO discharged through the stack 10 per cent, and increases the evaporation per pound of coal 7 per cent. These tests were run with coal from Macoupin County, Illinois, of the following composition:

Fixed carbon	37.47 per cent
Volatile matter	38.41 per cent
Moisture	9.89 per cent
Ash	12.23 per cent
B.t.u. per pound of dry coal	12,884

Both of the above tests were run with an 0-6-0 type switching locomotive, with a narrow firebox 40 in. wide by 106 in. long, with 29 sq. ft. of grate area. The air inlet through the ashpan was 5.7 sq. ft., or 20 per cent of the great area. The arch was 66 in. long and was supported on two arch tubes.

The final conclusions of the above test report also state that "the presence of the brick arch in the locomotive firebox increases efficiency and decreases fuel consumption, decreases the loss of heat units in smoke and ash discharged and reduces the visible smoke.

"The use of incorrect methods of firing, as indicated by the results of tests in which inexperienced firemen were employed, reduces efficiency, increases fuel consumption and fuel losses and increases smoke discharge."

Tests recently conducted on a Mikado type locomotive show smoke reductions varying from 50 per cent at low and medium rates of firing to 31 per cent at high rates, as shown by the curves in Fig. 1. The locomotive was hand-fired, using high volatile Penn gas coal screened over a

* From a paper read at the annual convention of the Smoke Prevention Association.

† Assistant to the president, American Arch Company.

1¼-in. mesh screen, the coal having the following composition:

Fixed carbon	54.00 per cent
Volatile matter	31.00 per cent
Moisture	.92 per cent
Ash	14.08 per cent
B.t.u. per pound of dry coal	13,088

This locomotive had 70 sq. ft. of grate area, a barrel combustion chamber 42 in. long, a 76-in. arch supported on four 3-in. arch tubes, an air opening through the ashpan of 7.80 sq. ft.—11 per cent of the grate area—and air openings in the grade of 20.21 sq. ft.—28.8 per cent of the grate area.

In these tests the increase in evaporation, due to the arch, varied from 8½ per cent to 15½ per cent. These three tests are probably the most thorough and reliable that have ever been conducted for the specific purpose of determining the effect of a brick arch on locomotive smoke abatement, and the test results are corroborated by the practical experience of railroad men throughout the country. The principal measures taken by railroads today to meet smoke ordinances consist of issuing firing instructions and equipping locomotives with brick arches.

While it is generally recognized that the brick arch will reduce the smoke emission from a locomotive, the reason therefor may not be clear. The formation of smoke is due primarily to the decomposition of the volatile hydrocarbons contained in all bituminous, semi-bituminous and lignite coals, though the presence of coal dust that is fed into the firebox and whirled out through the tubes unburned, adds to the smoke emissions.

Table I—Gas Samples Taken at the Top of the Fuel Bed

Lb. coal fired per sq. ft. of grate per hour	Thickness of fuel bed	Wt. in grams per cu. ft. of total gases at 60 deg. F. and 30 in. mercury									Soot and tar, per cent of total combustible
		C in CO	CH_4	H_2	C_2H_4	Total gaseous combustible	Tar	Soot	Total soot and tar	Total combustible	
22.3	6	2.034	.628	.209	.732	3.603	.528	.482	1.010	4.613	21.9
47.5	6	2.136	.142	.068	.036	2.382	.241	.369	.610	2.992	20.4
63.4	6	1.466	.215	.072	.107	1.860	.107	.215	.322	2.182	14.7
124.0	6	1.488	.018	.014	.326	1.846	.004	.016	.020	1.866	1.1
52.0	12	2.536	.484	.173	.242	3.435	.945	.477	1.422	4.857	29.3
105.5	12	2.522	.516	.241	.344	3.623	.658	.738	1.396	5.019	27.8
131.0	12	2.389	.036	.036	.036	2.497	.055	.092	.147	2.644	5.6
185.0	12	1.634	.108	.072	.036	1.850	.123	.415	.538	2.388	22.6

As the name indicates, the volatile hydrocarbons are compounds of carbon and hydrogen, and are of a very complex character. The heavier compounds are driven off in the form of tar in a semi-liquid or solid state, while the lighter hydrocarbons are driven off in a gaseous state. The distillation begins at a temperature around 400 deg. F., and is completed at a temperature of 1,600 deg. F. The decomposition of the volatile matter by the action of heat takes place very readily at temperatures above 1,400 deg. F.

The exact composition of the hydrocarbons when first distilled from the coal at the different temperatures is not known, as they break down so readily under the influence of heat and are so unstable that it is impossible to collect samples for analysis. The indications are, however, that the heavy hydrocarbons when first driven off contain by weight about 85 per cent carbon, 10 per cent hydrogen and 5 per cent oxygen. Under the influence of heat, these hydrocarbons break down into carbon, hydrogen, oxygen, lighter hydrocarbons of the methane (CH_4) series, and lighter unsaturated hydrocarbons.

The hydrogen is highly inflammable and burns readily if there is an oxygen supply above the fuel bed. The lighter hydrocarbons also burn readily if the oxygen supply is sufficient. If it is insufficient the hydrocarbon is broken down by the heat into carbon and hydrogen, the hydrogen either combining with the oxygen that may be present to form water or escaping into the tubes unburned.

Carbon does not exist in a gaseous state at temperatures with which we are familiar in furnace practice. When the various hydrocarbons are decomposed, the carbon is precipitated as a solid particle in the form of soot and these incandescent particles, floating in the flame, give it the luminous color. We are apt to think of this carbon as being set free and deposited in the form of atoms, but such is not the case. We have no knowledge of the atom existing as a unit, separate and distinct. The small particles of soot with which we have to deal are probably made up of a large number of carbon molecules. The very smallest soot particle that exists is this molecule, which consists of a number of carbon atoms (probably 12), held together by a sort of bond or attractive force of an electrical nature.

As a result the soot particles, which are the primary source of all smoke, have a very tenacious structure and are extremely difficult to break down when once formed. In order to burn them completely, it is necessary to supply a number of oxygen molecules sufficient to combine with each carbon atom, to bring them into contact with the carbon atoms at a temperature high enough to sustain combustion and to provide time sufficient for the combustion to be completed.

These conditions are similar to those met with in burning the "fixed carbon" on the grate, but are more difficult to fulfil. A piece of coke, or carbon, burning on the grate is held more or less in place until it is consumed. Combustion is accelerated by the high temperature prevailing in the fuel fed and by the violent scrubbing action of the oxygen in the air rushing through the fuel bed.

The particle of soot resulting from the breaking down of the hydrocarbons is well on its way to the tubes at the instant of its formation. It is not brought into violent mechanical contact with a supply of oxygen, but floats along in an atmosphere that has been robbed of much of its oxygen in passing through the fuel bed. The temperatures prevailing in the upper part of the firebox are generally sufficiently high to insure ignition and combustion, but under ordinary conditions the time available for combustion varies from 1/5 to 1/10 of a second, and this is insufficient.

With the conditions that prevail in the locomotive firebox, it is easier to prevent the formation of soot than to burn it when once formed. The precipitation of soot can be prevented only by having an excess of heated air (or oxygen) above the fuel bed, and bringing this heated oxygen in intimate contact with the volatile hydrocarbons at the instant they are distilled off. Research work done by the United States Bureau of Mines indicates that the hydrocarbons are decomposed when they have traveled but a few inches from the top of the fuel bed, and if the precipitation of carbon is to be prevented the air must be introduced at the top of the fuel bed and intimately mixed with the issuing hydrocarbons.

The chief function of the brick arch in abating smoke is that of a gas mixer. By baffling and compelling all of the gases to pass through a relatively restricted area above the arch an intimate mixture of the volatile combustible with

the oxygen is insured. While the mixing of the gases at the end of the arch does not take place soon enough to eliminate smoke entirely, it has the effect of reducing the smoke emissions, as shown by the tests quoted.

In a firebox without an arch carrying a characteristic fire—that is, with a bank of green coal under the fire door, the fire gradually becoming thinner toward the front end of the grate, where the draft has possibly pulled a hole in it—the bank of green coal under the door is expelling large volumes of rich hydrocarbons. These, passing up along the top zone of the firebox, are decomposed by the heat, causing the formation of soot which either escapes at the front end as smoke or is deposited on the heating surfaces to retard the flow of heat. At the same time a large excess of air is rushing through the thin portion of the fire on the front of the grate, and is passing directly into the lower tubes without in any way aiding the combustion of the hydrocarbons liberated in the back of the box and very often causing flue leaks or failures. Such conditions are not at all uncommon in locomotive fireboxes unequipped with the arch. Front end gas analyses often show a large excess of oxygen, due to the blast of air through the lower tubes, in combination with high carbon monoxide, hydrogen and hydrocarbon contents due to incomplete combustion of the volatile hydrocarbons arising from the bank under the door.

With the arch under similar conditions any excess air coming through the thin portion of the fire on the front of the grates is heated up, deflected and forced back over the end of the arch, where it is mixed with the gaseous combustibles arising from the green coal under the door. A heavy bank of green coal restricts the flow of air at the point where it is most needed and at the time when it is most needed—with the result that most of the hydrocarbons are broken down and the carbon precipitated before being brought into contact with the oxygen entering through the front grates. With the ordinary type of firebox the combustion chamber space and the flameway are insufficient to give all the particles of soot and combustible gas time to burn before reaching the tube sheet, but such a mixing as the arch affords results in a material reduction of the smoke, and under moderate rates of firing will result in almost complete combustion of the combustible gases.

TABLE II—HEAT DEVELOPED IN FUEL BED, AND POTENTIAL HEAT IN GASES, SOOT AND TAR

Constituent	Wt. grams per cu. ft.	Wt. lb. per cu. ft.	Heat value per lb.	B.t.u. per cu. ft. gas
Heat Developed in the Fuel Bed				
C in CO	2.136	.00471	4,500	21.2
C in CO_2	1.546	.00341	14,500	49.5
Total				70.7
Potential Heat in Gases, Soot and Tar				
C in CO	2.136	.00471	10,000	47.1
CH_4	.142	.000313	24,000	7.5
H_2	.068	.000149	62,000	9.3
C_2H_4	.036	.000079	21,600	1.7
Soot	.369	.000813	14,500	11.8
Tar	.241	.000531	16,000	8.5
Total				85.9

A light level fire should be carried, if smoke is to be reduced to the minimum. With the fuel bed maintained in this condition by a "scatter" type of firing, a uniform air supply is obtained throughout the fuel bed as well as a uniform distillation of the hydrocarbons. This facilitates the mixture of the oxygen and the hydrocarbons from the time they leave the top of the fuel bed, the arch mechanically accelerating this mixture.

Some authorities state that the decomposition of the hydrocarbons is caused by heating them up with an insufficient air supply and then bringing them in contact with the cooler heating surfaces or a draft of cold air. While later evidence tends to prove that this decomposition is caused entirely by heat, shafts of cold air through the firebox are objectionable—both from the standpoint of combustion and of boiler maintenance.

It is evident from the foregoing that the arch is not in itself sufficient to prevent smoke. Intelligent firing is also necessary. Smokeless firing and intelligent firing are almost synonymous, although there are conditions under which smokeless firing is impossible, regardless of the care and intelligence exercised by the fireman.

In some quarters there has been prevalent an idea that smoke was mainly a nuisance, and that the emission of dark clouds of smoke did not signify any appreciable heat loss. As a matter of fact, the emission of smoke not only indicates bad furnace conditions, but in many cases the soot and tar escaping as smoke may contain from 10 to 15 per cent of the heat value of the coal, and this will account for a considerable portion of our "unaccounted-for" heat losses.

Tests conducted by the United States Bureau of Mines (see Technical Paper 137) showed that when burning Penn gas coal as high as 32 per cent of the combustible arising from the fuel bed is accounted for in the soot and tar which is the source of smoke.

Table I, which is taken from the bulletin mentioned above, shows the composition of gases arising from the fuel bed and the percentage of the soot and tar therein contained. It is evident from these figures that the fuel bed acts chiefly as a gas producer, and a large part of the latent heat contained in the coal is liberated by the burning of combustible gases in the combustion space provided above the fuel bed.

For a specific example, take the second case shown in Table I, where 47½ lb. of coal are burned per sq. ft. of grate per hour, with the fuel bed six inches thick.

Table II shows in lb. per cu. ft. of gas the weights of the different gases leaving the fuel bed, the heat value per pound and B. t. u. per cu. ft. of gas. The gas has a total heat value of 156.6 B. t. u. per cu. ft., of which 70.7 B. t. u., or 45 per cent, are developed in the fuel bed and 85.9 B. t. u., or 55 per cent of the total heat contained in the coal, are developed by the burning of the combustible gases above the fuel bed.

The tar and soot shown in the foregoing table contains 12 per cent of the heat in the coal. If one-half of this were to escape unburned as smoke, the resulting heat loss would be six per cent; and such losses are constantly occurring.

The amount of heat developed by the gases burning above the fuel bed will serve to illustrate the importance of firebox volume and combustion chamber space, and will also explain why intelligent firing with the use of a brick arch is not always sufficient to prevent smoke. The ordinary firebox in service to-day has not volume and combustion chamber space sufficient to provide the time element that is essential for the complete combustion of volatile hydrocarbons and the total elimination of smoke. This deficiency has been recognized by some of our railroads and during the past few years many fireboxes have been provided with combustion chambers, particularly in locomotives of the 2-10-2 and Mallet types, but combustion-chamber engines are few, when compared with the total number of locomotives in service.

It is also probable that we have been too conservative as to the length of combustion chambers that have been installed. Tests indicate that an 18-ft. or 19-ft. tube is sufficient to reduce the front end temperatures to a normal figure. Tubes of this length, when used in conjunction with a firebox of ample grate area and long combustion chamber, result in a boiler design that gives both high efficiency and high capacity.

Fig. 2 shows a type of combustion chamber that is being

used successfully in oil-burning service on some 2-10-2 type locomotives. This firebox has a combustion chamber 41½ in. in length between tube sheet and bridge wall, firebox volume of 435 cu. ft., and an average flame path of 19 ft.

With a fuel oil containing 85 per cent carbon, nine per cent hydrogen and six per cent oxygen, weighing 7.43 lb. per gallon, having a heat value of 18,878 B. t. u. per pound, it was found that one square inch of air opening in the pan per gallon of oil burned per hour was sufficient to obtain

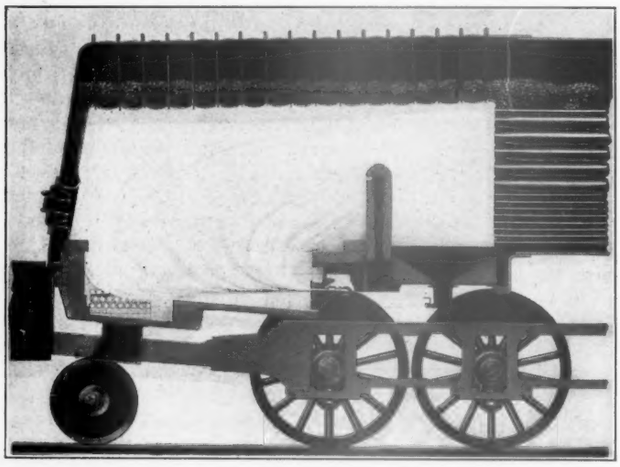


Fig. 2—Gaines Wall Applied to an Oil-Burning Locomotive

complete and smokeless combustion, even when burning 4,000 lb. of oil per hour. At this rate of combustion, an indicated boiler efficiency of 85 per cent was obtained with the Gaines wall in place. With the wall removed the boiler efficiency was 74 per cent, or a difference of 13½ per cent in favor of the wall. With the wall removed, at a rate of combustion of 4,000 lb. of oil per hour, there was a very noticeable increase in the amount of smoke emitted. This serves to show the need of a baffle or some sort of mechanical mixing device that will insure the thorough mixture of the air with the combustible gases.

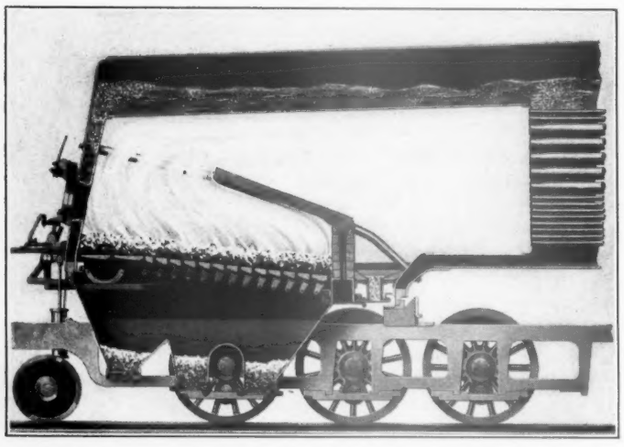


Fig. 3—Combination Combustion Chamber and Gaines Arch

For coal-burning service, a modification of the above design is being used most successfully on several railroads. This combination of the bridge wall with air ducts through the wall admitting a secondary air supply above the fire is known as the Gaines Locomotive Furnace. Here an attempt has been made to increase the firebox volume and flameway by reducing the tube length and installing a combustion chamber between the bridge wall and the tube sheet. This firebox has obtained some of the results desired, but for high volatile coal burned at high rates of combustion the combustion chamber space is too limited.

Fig. 3 shows a Gaines furnace in combination with a barrel combustion chamber. Here additional firebox volume and flameway have been obtained by materially increasing the length of the combustion chamber and, as this particular design was used on Mallet engines, this result was obtained without unduly shortening the tubes.

Fig. 4 shows a Gaines furnace installation in the same size firebox, with the barrel combustion chamber eliminated. This firebox has a grate area of 90 sq. ft. and more than 400 sq. ft. of firebox heating surface, with an effective volume of more than 500 cu. ft. The average length of flameway or gas passage is 15 ft. and the over-all length of the firebox is 18 ft. 3½ in. This represents the latest endeavor to secure adequate firebox volume and flameway.

While the results obtained from this type of furnace have proved most satisfactory, there is still room for improvement in the matter of smokeless combustion. The scientific training of firemen, the use of brick arches and the installation of combustion chambers have all tended to reduce the visible emission of smoke, but the burning of high volatile coal at high rates of combustion with the total elimination of smoke has not yet been successfully accomplished; and the indications are that some radical changes in locomotive firebox design and methods of firing coal will be necessary for the accomplishment of this object.

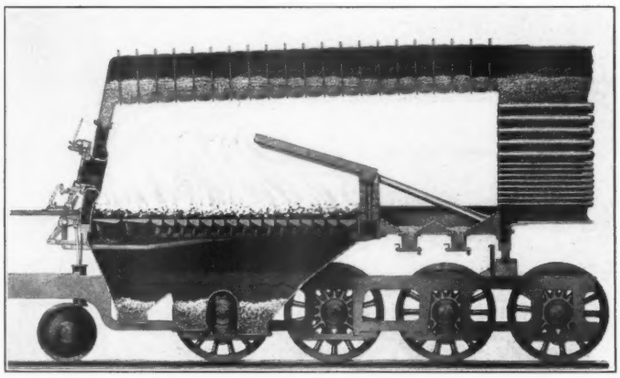


Fig. 4—Gaines Furnace with an Effective Volume of More Than 500 Cu. Ft.

MECHANICAL DEPARTMENT A FACTOR IN TRAIN LOADING*

BY T. T. RYAN
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The principal thing that operating officers can do to increase tonnage on single track roads is to so despatch that the freight trains will have the open door and then keep them moving. Engines and cars with bearings warmed up and lubricated will run free and pull easily, while if the same equipment is run in and out of a dozen side tracks over the division it will pull vastly harder and the cost of operation will increase. Also by their tact and methods of approach operating officers can create an esprit de corps that will automatically increase tonnage. The chief factor in increasing tonnage does not lie with the trainmaster, but with the master mechanic; we can trust the trainmaster to "hang 'em on" if we are ready to "pull 'em." There are many ways to increase the efficiency of the engines. The boilers should be kept scrupulously clean and free from scale. The effect of

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dirty boilers and the action of scale as a non-conductor should be explained to the men. Next see that fireboxes, flues and front ends are kept free from leaks so that the draft will be unimpeded. This seems like unnecessary advice, but an examination of the 70,000 engines in the United States will disclose that it is needed.

If these things are done we will have free steaming engines. This in turn means that an engineer knows when he gets the "gate open" he can go; you cannot expect an engineer to watch a falling pointer and at the same time try to handle tonnage. The good effect of these features will be largely minimized if coal is not properly selected and sized, for there are few things more discouraging to enginemen than poor coal and to shop men than engines which do not steam owing to irregularity in the quality of coal. Both are expensive to the railway.

If these and the minor things about the engines are done and done well when they should be, the engines in their turn will pull the maximum rating and do it every day. Then if the despatcher will use the zeal he should in getting men over the road and *encourage them to make* a good run instead of a poor run we will increase our tonnage 20 per cent without a dollar of capital outlay.

This does not, however, mean that we should not modernize old engines. First in this line come brick arches. The application of arches to all the old power would mean the equivalent of 4,000 engines added. The application of superheaters to engines not yet superheated means the equivalent of 20,000 more engines.

Did we ever hear the best engineer on our territory say the train he had last trip pulled like two trains and he could not get it going? What was the reason. Friction of course, caused by brakes sticking owing to foundation gear binding, too little shoe clearance, and dry bearings with improper area. What is the remedy? Inspect the gear and know it is right and kept so. Inspectors are supposed to get cars through the terminals with a test of about a minute per car; they get them through all right, but the road pays for it in loss of tons and in excess of coal consumption and overtime. The remedy is to see that the car is right from point of origin to destination.

LOCOMOTIVE TERMINAL DETENTION RECORDS

The demand for power is now so great that every effort must be made to keep it working effectively a maximum percentage of the time. One of the largest sources of delay is at the terminal and any means by which this delay can be analyzed and corrected will serve to increase the total locomotive supply. The Pennsylvania Railroad uses a form for gathering this information which shows the movement of a locomotive from the time it arrives at the terminal until it leaves.

The form shown in Fig. 1 is made out daily by the roundhouse force and includes information of interest to the transportation department, as well as the mechanical department.

M. P. 99

PENNSYLVANIA RAILROAD COMPANY

MOVEMENTS OF LOCOMOTIVES AT _____ DIVISION

FROM MIDNIGHT TO MIDNIGHT _____ 191__

LOCOMOTIVES ARRIVING

LOCO. NUMBER	DIVISION	KIND OF SERVICE	TRAIN NUMBER	ENGINEMEN	FIREMEN	TIME CREW IS AVAILABLE	ARRIVED AT TERMINAL	TIME FROM TERMINAL TO PIT TRACK	ARRIVED AT PIT TRACK	TIME FROM PIT TRACK TO ENG. HOUSE	ARRIVED AT ENG. HOUSE	TIME FROM ARRIVAL AT PIT UNTIL LOCO. IS READY FOR SERVICE	TIME READY FOR SERVICE	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

LOCOMOTIVES DEPARTING

TRAIN NUMBER	TIME ORDER WAS PLACED	TIME ORDERED FOR SERVICE	ENGINEMEN	TIME REPORTED	FIREMEN	TIME REPORTED	TIME LOCO. LEFT STORAGE TRACK	TIME LEAVING TERMINAL WITH TRAIN	TIME FROM READY FOR SERVICE TO TIME ORDERED	TIME FROM READY FOR SERVICE TO LEAVE TERMINAL WITH TRAIN	TIME FROM ARR. AT PIT TRACK TO TIME READY FOR SERVICE	TOTAL TIME FROM ARRIV. AT TERM. TO DEPT. WITH TRAIN PLUS TIME FROM TIME READY FOR SERV. TO DEPT. FROM TERMINAL	TOTAL TIME FROM ARRIVAL AT TERMINAL TO DEPARTURE FROM TERMINAL	REMARKS
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

Fig. 1—Daily Report for Recording the Movement of Locomotives Through Terminals

This form furnishes a complete record of all locomotives arriving and departing from the enginehouse between midnight and midnight. At midnight all computations of time automatically cease and the locomotive numbers of all locomotives remaining within the enginehouse or yard territory are carried forward to the sheet for the following day and the computation of the time starts at 12:01 a. m. The time shown under the column immediately preceding the column in which the midnight time is recorded should be carried forward to the next daily sheet for information. A second form, Fig. 2, gives a daily summary of the average time the locomotives spend in passing from one point to another in the terminal.

Referring to Fig. 1, the daily detail report of each locomotive: Columns 1, 2, 3, 4, 5 and 6 are self-explanatory.

Column 7 shows the time at which the crew shown in columns 5 and 6 will again be available for service. Column 8 shows the time the locomotive and train arrive at the terminal, this time being taken from the engineman's time card or work report. In general the point at which this time is to be taken should be that at which the yard delays begin. Column 9 shows the time elapsing between the time of arrival at the terminal and the arrival of the locomotive at the pit track and is one of the items tabulated in column *A* (Fig. 2) of the summary. In case midnight intervenes between the time the locomotive arrives at the terminal and the time it arrives at the pit track, the time in column 9 is computed to midnight and the locomotive number and the time shown under column 8 are carried forward to the sheet for the following day. Column 10 shows the time that the locomotive arrives at the pit track or other points at which the engine crew is relieved, this time to be noted by the engineman on his work report. Column 11 shows the time elapsing between the arrival of the locomotive at the pit track and at the enginehouse or the point at which the repairs are to be made and is the difference of the time shown in columns 10 and 12. Column 11 is shown in Fig. 2, the summary, as column *B*. The same rules apply regarding midnight as before described. Column 13 shows the time elapsing between the time the locomotive arrives at the enginehouse (column 12) and the time it is ready for service (column 14). This information is shown in column *C* in the summary. The use of column 15 is obvious.

Where a locomotive arrives at an enginehouse and is to be sent to the shop, it is to be dropped from the daily report sheet after the time shown under column 12, and locomotives arriving at a terminal from the shop begin their record on the daily sheet at column 12. Where locomotives remain at enginehouses for heavy repairs, a record of the repairs to be made is noted on each daily report. The time in column 13 may or may not be kept separate for locomotives requiring over 24 hours for repairs and separate averages computed as between locomotives requiring under 24 hours for repairs and those requiring more than that.

Columns 16 to 23 are self-explanatory, column 23 being the time at which the locomotive and crew leave the enginehouse territory. Column 24 shows the time that the locomotive and train clear the terminal yard for freight trains, or the time the train leaves the terminal for passenger trains. Column 25 shows the time between the time the locomotive was ready for service and the time it was ordered, being the difference between columns 14 and 18. This is shown in column *D*, Fig 2, of the daily summary. Column 26 shows the time between the time the locomotive is ready for service and the time it leaves the terminal with its train. This time is shown in the summary sheet under *E*. Column 27 shows the time the engine has spent in the hands of the mechanical department from its arrival at the pit track to the time it is ready for service, or, in other words, the time elapsing between that recorded in columns 10 and 14, or, again, the sum of the computed time shown under columns 11 and 13. This information is shown in column *E* on the daily summary, Fig. 2. Column 28 shows the time the engine is at the terminal for which the transportation department is responsible, it being the sum of the time shown in columns 9 and 26. This information is shown in the daily summary sheet under column *G*. Column 29 shows the total time the locomotive spends in the terminal which is equivalent to adding the computed time shown under columns 27 and 28 of Fig. 1, or columns *F* and *G* in Fig 2.

By this means the movement of each locomotive and the average movement of all locomotives through a terminal are readily determined. The performance may be analyzed and the work of various terminals checked. Conditions, of course, will vary at different engine terminals, which makes the comparison of one terminal with another difficult; but where a locomotive seems to spend too much time either in the hands of the mechanical or the transportation department, a positive record of just what has transpired is at hand and opens the way for a satisfactory investigation. This information is usually gathered by the clerk at the roundhouse who keeps the enginemen's reports. At large terminals, separate sheets may be used for locomotives in each kind of service, such as passenger, freight and work or shifting. Each daily report is in the hands of the superintendent of motive power early the next morning with the averages determined, so that he is able to get a general idea of each terminal under his jurisdiction.

AVERAGE MOVEMENT OF ROAD FREIGHT LOCOMOTIVES.....DIVISION. AT.....ENGINEHOUSE.
MONTH OF.....1917.

Date	Number of Locomotives Despatched	Column 9 A		Column 11 B		Column 13 C		Column 25 D		Column 26 E		Column 27 F		Column 28 G		Column 29 H		Remarks.
		Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	
1																		
2																		
3																		
30																		
31																		

Notes:
Column 9 Letter A—Time from Terminal to Pit Track.
Column 11 Letter B—Time from Pit Track to Enginehouse.
Column 13 Letter C—Time from Arrival at Enginehouse to Ready for Service.
Column 25 Letter D—Time from Ready for Service to Time Ordered.
Column 26 Letter E—Time from Ready for Service to Leaving Terminal with Train.
Column 27 Letter F—Time from Arrival at Pit Track to Ready for Service.
Column 28 Letter G—Total Time from Arrival at Terminal to Arrival at Pit Track, Plus Time from Time Ready for Service to Departure from Terminal.
Column 29 Letter H—Total Time from Inbound Terminal to Departure from Outbound Terminal.

Fig. 2—Summary of Average Movement of Locomotives Through Terminals

Columns 16 to 23 are self-explanatory, column 23 being the time at which the locomotive and crew leave the enginehouse territory. Column 24 shows the time that the locomotive and train clear the terminal yard for freight trains, or the time the train leaves the terminal for passenger trains. Column 25 shows the time between the time the locomotive was ready for service and the time it was ordered, being the

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Compound for Rawhide Pinions.—Ordinary hydrocarbon oil is most destructive to rawhide pinions, and the fact that rawhide pinions have gained a bad name is entirely due to the use of this lubricant. One of the best compounds for rawhide pinions is given in Marine Engineering of Canada as follows: Plumbago, 15 per cent; resin oil, 55 per cent; resin, 30 per cent. Cloth and paper pinions can be lubricated without injury with ordinary oil.

RECLAIMING CAR MATERIAL ON THE ROCK ISLAND

A systematic campaign to secure the reworking of all serviceable material removed from cars or picked up along the tracks has been carried on for sometime on the Rock Island Lines. As a result the reclamation of material has been developed to a degree that was hardly thought possible when the project was started. Until about two years ago reclamation work was carried on almost entirely at the large shop points. A plan has been devised for taking care of as much of the work of reclamation as can profitably be handled at the points where the scrap originates.

In this way considerable freight and handling has been

Reclaimed Roofing, Siding and Decking Ready for Use

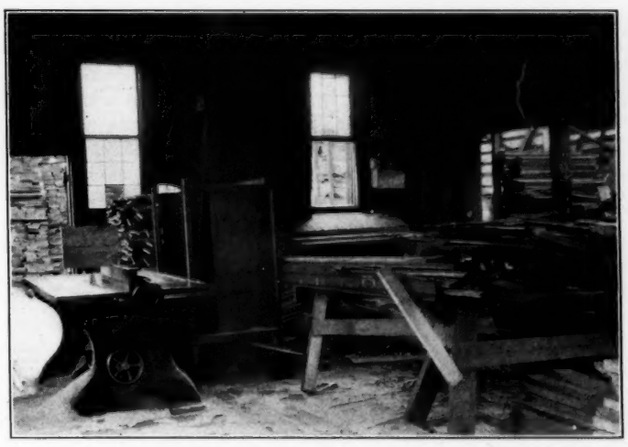
saved on some of the material that can be reclaimed without special equipment. The foremen of all shops were asked to prepare statements showing what material was being reworked and the parts made from scrap. These statements were combined in a single list, which was sent to all master mechanics and shop foremen, with the request that they furnish monthly statements of additional material which had been reclaimed. Many new uses for scrap are constantly being found, and from time to time new lists are sent out.

One of the most interesting features of the work is the large number of uses which have been found for scrap wood. Old car sills are sawed up to make sills for steel cars, sub-carlines on inside roof cars, sill splices, nailing stringers, posts and braces, purlines, grain strips and roof saddles. If all the sills cannot be used for these purposes, they are made into fence posts or stringers for building purposes. Old draft timbers are also used to make fence posts as well as dirt car stakes, ice tank crossties and grade stakes. Braces are cut off and used on lower cars or converted into cripple posts or dirt car stakes. Old siding and lining is cut off and used for smaller cars and for the short siding in doorways and around windows and cupolas of caboose cars. Part of it is cut up for roof boards, stock car end lining and insulation for refrigerator cars.

Old flooring is used for flat, coal and ballast car floors by splicing, for dump car doors and for stock cars. Running boards are used for stock car end linings and for latitudinal running board extensions. Coal car side planks are cut up for end planks, for grade stakes, nailing stringers and purlines. Sub-sills are used to make running board saddles and stock car braces. Carlines are used for refrigerator ice bunker reinforcing.

Some novel uses have been found for metal parts removed from cars. Arch bars are made into carrier iron, brake levers, striking plates, tie straps and switch engine foot board brackets. Drawbar yokes are also used for many of these parts. Bottom arch bar straps are used for door shoes on box cars, and for corner bands. Door rails of Z bar section are used for reinforcing doors, while stock car door tracks are formed into scrap for draft lug castings. Grab irons which cannot be used again are made into cellar bolts and brake beam safety chain hooks. Old sill steps are made into pipe clamps, running board brackets and uncoupling rod brackets. Scrap truck tie straps will make three dead lever fulcrum plates.

The monthly reports serve to sustain interest in the re-



Shop in Which Lumber is Reclaimed

clamation work and methods have been found for using many parts which ordinarily would have been scrapped without being given a second thought. Scrap coil springs are now made into pinch bars and clawbars, while flat springs are used for making wrenches. Coil springs of ½ in. and ⅝ in. diameter stock are made into packing irons and hooks. Body bolsters of the built up type with the filler casting broken out of the center are reclaimed by applying pieces of channel iron from scrap truck channels. Discarded roof sheets are worked over to make smaller sizes and are also used for stove pipes, smokejacks, stove bases and drip pans. Refrigerator hair felt is reclaimed to be

used as padding for hatch plugs. Even the salt removed when repairing refrigerator cars is utilized, as it has been found very satisfactory for thawing switches and also for putting into fire barrels to keep the water from freezing.

The amount of material reclaimed has increased to a remarkable degree since the plan of sending out the lists to all the shops was put into effect.

PIECE WORK AND CAR INSPECTORS' DUTIES*

BY W. H. SITTERLY

Everyone is working under the most strenuous conditions that have ever confronted us in our railroad life. Our work is harder, due to the fact that more supervision is necessary on account of the calibre of men we are now handling. I mean inexperienced men, as a great many of our co-workers have been called to other fields of labor or to the front. Therefore, the man of the hour is the man who can stand on his tip-toes and meet the conditions that now confront us.

THE PIECE WORK INSPECTOR

The duties of a piece-work inspector are many and of considerable importance to the company he represents and to the foreman under whom he serves. To my mind, the piece-work inspector is a high-class foreman. He must know what work is included in the operation in accordance with the piece-work chart that he works under, and the price paid for the operation. After the repairs are completed, he must inspect in detail each operation to ascertain if the work has been properly and mechanically performed. It is also necessary for him to be thoroughly conversant with the M.C.B. rules, in order that he may determine whether the items of repairs that his men have performed are chargeable to the foreign line or if they are of such a character that the owner is not responsible for the conditions. In this case, he must honestly handle the matter so that the amount of labor and material covering the item will be absorbed by the company he represents. He must be a man thoroughly conversant with car construction, which will enable him to decide quickly and properly whenever matters are put up to him. He should be a student of human nature and know each one of his men—that is, their peculiarities and shortcomings. He must so distribute the work among the men, that he cannot be suspected of showing partiality. If the above qualifications are lacking, the interests of both the company and the men are likely to suffer.

Errors will be made, but proper supervision should correct these errors should they obtain. Piece-work inspectors should see at all times that the men are supplied with the proper tools and that they are in good repair; also, that the proper amount of material is on hand to make repairs. These two items carefully followed, insure satisfied men and quick repairs.

In preparing piece-work cards, the successful and alert piece-work inspector will so word the items of repairs that the M. C. B. billing clerks can intelligently prepare a repair card from the information furnished by him. Each piece-work card involving a foreign car should show specifically the items billable against the owner, likewise the no-bill. Correct original records reflects a great deal of credit on the maker of such records when an investigation is made.

Another duty of the piece-work inspector which means much to the management, is that of carefully supervising the repairmen, to see if they are resorting to sharp practices.

Last, but not least, a strict observance of the M. C. B. Rules of Interchange pertaining to the repairs of cars and the ability not to be moved from this strict interpretation by strong arguments presented must be had. A slight deviation from the rules in time leads to greater deviations.

The foregoing are not impossibilities, but conditions under which every piece-work inspector should work.

CAR INSPECTORS

Car inspectors in C. T. yards generally are men that graduate from the repair track, and their duties should consist of inspecting cars in the receiving yard and the classification or departure yards.

In the receiving yard, they should inspect for defects which would prevent the cars from going to destination without repairs, and the cars will either be marked to be set on repair tracks or so marked that repairman who follows the inspectors, will make the repairs. Good judgment is required from the inspector, for every car he keeps off the shop track, money is saved for the company he represents, and the more repairs that are made in the C. T. yards the easier will be the burden of the yardmaster, who we think at times is hard on us as car men. Sometimes I feel that way myself, and other times I see the multitude of things he has to do and a great many times with cramped and inadequate facilities. I then become charitable with him.

The car inspector working on the classification or departure track must inspect for safety the running gear of the car. Likewise, the safety appliances. See that they are in proper repair and in their places. He must also inspect loads in open top cars to ascertain if they are properly chocked and blocked, also that load will pass the clearance dimensions over the route it is to travel. He must make inspection of the journal boxes and contained parts on the car to ascertain if they are in proper condition, and if not, to mark car for identification by the oiler.

While engaged in these daily duties, the car inspector on the C. T. track must, if he desires promotion to the interchange track, thoroughly familiarize himself with the M. C. B. rules, which include the M. C. B. loading rules, tank car specifications, and bureau of explosives regulations. He must also be thoroughly familiar with the cars owned and operated by the railroad with which he is employed, so that when he goes to the interchange track, he is in position to detect wrong repairs on the equipment. In other words, the car inspector successful in receiving promotion is one that does things and does not wait to be asked to do them.

The car inspector at the interchange track carries in his pocket the check book of the company he represents. By this I mean the defect card. In this district, under the Niagara Frontier Car Inspection Association, he is carrying the other fellow's check book, and with it he guards the interests of the company he represents. If we were working in this district under straight M. C. B. rules, he would be called upon by his neighbor for a defect card. However, in this district under the rules we are working, he is carrying the check book or defect card of his neighbor. He must know absolutely the intent and meaning of the M. C. B. rules of interchange insofar as the interchange of cars is concerned—that is, what constitutes a delivering company's responsibility and what is the owner's. His interpretation must be such that he can stand behind it at all times if he refuses a request made upon him unjustly for a defect card.

He must know thoroughly the construction of his company's cars so that he can protect them on the return home in the case of wrong repairs. He must be thoroughly conversant with the loading rules, and, if necessary, to demand an adjustment order, if adjustment is necessary, on the load when ordered. Also, if called upon to visit an industry on the rails of the company he is employed by, give a decision for loading material. He must know when and why to demand a transfer order against a car that is being delivered which must necessarily be transferred.

Added to all of this is the keen judgment brought about by experience to know when a car must or must not be shopped.

* Abstract of a paper presented at the Niagara Frontier Car Men's Association.

TRAIN BRAKE LEAKAGE DETERMINATIONS*

Tests Made With an Orifice Supplying Maximum Allowable Leakage and Brake Pipe Pressure Observed

BY C. R. WEAVER
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THE customary practice in determining the brake pipe leakage in a train made up ready for departure is by making a 10-lb. brake pipe reduction, lapping the brake valve and noting the rate of drop in the brake pipe pressure. From this, together with the volume of air in the train, the cubic feet of free air lost for a definite period of time is determined. This is accepted as a measure of the relative condition of the trains on the road with respect to leakage from the brake system.

After an extended investigation of long freight trains, the writer was convinced that the information so obtained was of little value and rather misleading than otherwise. Trains were found on which the brake pipe leakage, as noted above, was not excessive, and the compressor capacity ample to supply the air required for maintaining the pressure in the brake system, but subsequent observations on the road showed the compressor capacity insufficient to supply the air lost.

There are several causes for apparent disagreement of such observations, namely:

(1) Opening up of leaks in hose couplings and pipe connections when the train is in motion that do not exist when the train is standing.

(2) Leakage caused by movement of apparatus when running due to insecure fastening of reservoirs or brake cylinders to the car body.

(3) Leakage from the auxiliary reservoir side of the triple valve piston caused by leaky gaskets, leaky release valves, etc.

How much influence these causes may have is uncertain, but the fact remains that trains having no more brake pipe leakage, measured in the usual way, than could be easily supplied by the compressor capacity, have been found in numerous cases to overtax the compressor, causing its failure.

It is very difficult to ascertain brake pipe leakage, in fact, it can only be done by closing all the triple valve cut-out cocks throughout the train, which is impracticable and of little value, since it is the volume of air that escapes from the system that is now the vital consideration as far as train movements are concerned, i. e., time to charge the brake system and to restore and maintain the required pressure.

There is, however, another side of this: viz., the effect of the brake pipe leakage on the operation of the brakes, such as lessening the ability to release all the brakes in the train, and lengthening the time in which they can be released. The leakage may also become so great that a brake application commenced by the engineer may result in a continuous application of the brakes. However, this is hardly likely to become serious with the long, large volume air brake trains of to-day, since the capacity of the compressor, the limitations of transmission of the air by the passageways of the brake valve and feed valve, and the ability to transmit air in sufficient quantity through the pipes of the present long trains will be exceeded before the brake pipe leakage, in pounds per minute, has any serious effect upon the operation of the brakes.

For instance, 5 lb. leakage from the brake system,—equivalent to about 20 lb. per minute with triple valve cut-out cocks closed,—obtained by merely lapping the brake valve, will not materially interfere with the application and release of the brakes, but 5 lb. of air leakage per minute from a 100-car train of 10-in. equipment will amount to 65 cu. ft. of free air per minute. This amount of air leaking from the system of a 100-car train in one minute would not interfere with the operation of the brake as far as application is concerned, but it might seriously interfere with the release of the brakes, since it reduces the ability by 65 cu. ft. of air per minute to raise the pressure in the brake pipe at the rate required to insure release. The compressor may have but little, if any, margin above that required merely to replenish the leakage. In other words, it is clear that if the leakage is kept down to a point where the compressor, the brake valve passages and the brake pipe resistances, and not the leakage, are the chief governing factors of the rise of the pressure in the system, as they should be, there is no need to fear the effect of brake pipe leakage on the operation of the valves in the brake system.

To accomplish this end, it must be understood that the leakage on individual cars must be less under present day train operation than before the present large volume of air was aggregated in one train.

The whole question of brake pipe leakage resolves itself into what quantity of air may be permitted to escape from the brake system and still permit charging, maintaining and replenishing the brake system in such time as will not impose limitations upon traffic in the way of delays, getting the trains ready in the yard, and operating them over the road.

It is very difficult to ascertain what quantity of air is actually leaking out of the brake system. It is not difficult to find out what drop takes place in the pressure, but this varies owing to variations in methods of making tests, positions assumed by triple valves, etc. It is not difficult, however, to fix on some quantity of air that may be permitted to leak out of the brake pipe and then supply in the yard this quantity of air to a train previously charged and observe whether or not the quantity supplied does, or does not, maintain the required pressure. If it maintains or more than maintains the pressure, it is apparent that the leakage of the train is no more than can be permitted. If it does not maintain the pressure then the leakage must be reduced to the point where it can be maintained. The permissible amount of leakage from the entire brake system is the starting point. Too much leakage must not be allowed or an undesirably large compressor capacity or high degree of compressor maintenance will be necessary. An excessively low amount of leakage must not be insisted upon, or traffic will be interfered with on account of the time required to stop the leaks.

In order to arrive at some basis of what would be the allowable leakage, the Interstate Commerce Commission condemning tests of air compressors is the basis of the available compressor capacity. This, by the way, in the writer's opinion allows too wide a variation in the condemning tests. A New York No. 5 compressor is only required to deliver 59 cu. ft. of air, which is only 65.5 per cent of its capacity when in good condition, whereas the 8½-in. cross-compound com-

*Abstract of a paper presented at the September meeting of the Central Railway Club.

pressor is required to deliver 86 cu. ft. of free air, which is 90.5 per cent of its good condition performance.

DETAILS OF TESTS

A method of measuring total train leakage by means of a charging orifice has been suggested and the tests referred to herein were made to determine the proper orifice to be used, the form of the apparatus and its manipulation.

A 100-car freight train was used, conforming to the following specifications:

Size of equipment, 10-in. (combined); length of cars, 42 ft.; brake pipe volume per car, 920 cu. in.; auxiliary reservoir volume, 2,440 cu. in.; leakage uniformly distributed at car 4 and every tenth car up to and including car 94, regulated by cocks in the branch pipe near the triple valve; test gages on branch pipes of cars 1 and 95 and on auxiliary reservoir of car 1.

A special test apparatus was used as equivalent to a yard charging plant. In addition to the charging orifice this contained an air meter (a Toolometer) which gave a direct reading of the amount of air supplied to the train through the orifice for any test condition. It contained a reservoir, the purpose of which was to stabilize the pressure at the orifice.

Some tests required the use of a locomotive the equipment of which was as follows:

Brake equipment, No. 6 ET; main reservoir volume, 50,000 cu. in.; main reservoir pressure, duplex control 100 lb. and 130 lb.; compressor, two 9½-in. or one 8½-in. CC.; steam pressure, 195 lb. to 210 lb.; test gages on main reservoir and brake pipe.

Two main classes of tests were made which may be referred to as charging tests and pump up tests. The special apparatus was used for the charging tests and the locomotive with compressors was used for the pump up tests. Determinations of leakage were also made by the ordinary brake pipe leakage method to compare with the results obtained in the charging tests.

The first charging test was made using an orifice roughly computed to furnish an amount of air equivalent to 75 per cent of the capacity of a New York No. 5A compressor as determined by the condemning test of the Interstate Commerce Commission, which requires this compressor to deliver approximately 59 cu. ft. at 100 single strokes per minute. The orifice was computed to be such a size that with a yard supply pressure of 80 lb. and 70 lb. in the brake pipe of the first car of the train it would supply air to the train at the rate of 75 per cent of 59, or about 45 cu. ft. of free air per minute. This basis is not correct, because it does not take into account the steam pressure and compressor speed which would be obtained when a locomotive compressor is charging the train. However, the basis was agreed to as a starting point for the tests and the pump up test results served later as a new basis for deciding what the size of the charging orifice should be to furnish the maximum amount of train leakage to be permitted.

The orifice computed to the nearest common size drill was 17/64 in. in diameter through metal 1/16 in. thick. Using this orifice in the apparatus and with the supply reservoir maintained constant at 80 lb. pressure the uniformly distributed brake pipe leakage of the train was increased until the air flowing through the orifice was just able to maintain 70 lb. pressure in the brake pipe of the first car. When this balance of pressure was obtained the Toolometer by-pass was closed and a reading taken of the amount of air or rate required to supply the leakage so obtained. This rate was found to be 41 cu. ft. of free air per minute and the pressure noted on the 95th car was 61¼ lb., or a drop in pressure of 8¾ lb. between the front and rear of the train.

This rate of leakage was assumed as the basis for making pump up tests, using the locomotive with two 9½-in. compressors and 200 lb. steam pressure instead of the yard plant apparatus. The first pump up test was made starting with the train empty, brake valve handle in service position, main reservoir pressure at 130 lb. and by moving the brake valve handle to running position. The movement of the brake valve handle began the charging of the train through the feed valve and at the same time operated to reduce the main reservoir control to 100 lb. pressure. At various time intervals the main reservoir pressure and the brake pipe pressures on the locomotive, car 1 and car 95, were simultaneously observed. The time required by the two 9½-in. compressors to charge the train through the feed valve to 70 lb. pressure on the head end was measured in this manner. This test was then repeated, except that the brake valve was first placed in full release position and held there until the auxiliary reservoir on car 1 reached 65 lb., when it was moved to running position. This test was made to show how much time could be saved in charging the train by avoiding the use of the feed valve until it was necessary to avoid over-charging. The effect of larger compressor capacity on the time required to charge the train under these conditions was shown by repeating the above test after substituting an 8½-in. CC. compressor for the two 9½-in. compressors.

When the train was charged up to 70 lbs. pressure on car 1, and while using the two 9½-in. compressors, an attempt was made to increase that pressure from 70 lb. to 85 lb. by placing the brake valve handle in full release position. After more than 20 minutes the pressure became stationary at 82½ lb. Later the yard plant apparatus was connected to the train and the pressure against the orifice raised until the brake pipe pressure on the first car was maintained at 85 lb. The Toolometer reading showed that it was necessary to supply air at the rate of 50.4 cu. ft. of free air per minute to maintain the total train leakage under these conditions.

It was then concluded that the total leakage rate of 41 cu. ft. of free air per minute at 70 lb. pressure on car 1 was too great, and that the yard plant orifice area and the corresponding total leakage rate should be reduced. This conclusion was based on the assumption that two 9½-in. compressors in good condition would be equivalent to one New York No. 5A compressor when in the condition determined by just passing the I. C. C. condemning test. It was recognized that this assumption was not strictly correct, but as it was not possible to use a No. 5A compressor it was agreed that these two compressor combinations were nearly enough equivalent to base the pump up test results on the two 9½-in. compressors. In this same connection it was also pointed out that the final determination of the maximum permissible total train leakage would depend largely on how the proposed method of testing this leakage should affect the time required both to make up the trains and also to handle them over the road in actual service.

Following the tests described the yard plant apparatus was reconnected to the train and the charging orifice size reduced from 17/64 in. to ¼ in. in diameter. While maintaining an air pressure supply of 80 lb. for this orifice the uniformly distributed train leakage was adjusted as before described until this orifice was able to maintain a brake pipe pressure of 70 lb. on the first car of the train. The Toolometer reading under this condition showed a total leakage rate of 35 cu. ft. of free air per minute.

The locomotive using the two 9½-in. compressors was again connected to the train and a pump up test, starting with the brake valve handle moved to running position was made similar to the one previously described, except for the reduced amount of total leakage. When the train was charged to 70 lb. pressure on car 1 the feed valve setting was raised and the time noted to raise the brake pipe pressure from 70 lb. to 85 lb. pressure on car 1. This time was about 15 minutes. It was then concluded that the rate of total train leakage of 35 cu. ft. of free air per minute as determined by using a ¼-in. orifice with the yard plant supply pressure of 80 lb. to charge

the train to 70 lb. on the head end would be a correct basis for fixing the size of the testing orifice.

The above pump up test was then repeated under the same conditions, except the brake valve was first moved to full release position until the auxiliary reservoir on car 1 was charged to 65 lb. pressure when the brake valve handle was returned to running position. This test was made to show how much time could be saved in charging the train by avoiding the brake valve running position without over-charging the head end of the train too much.

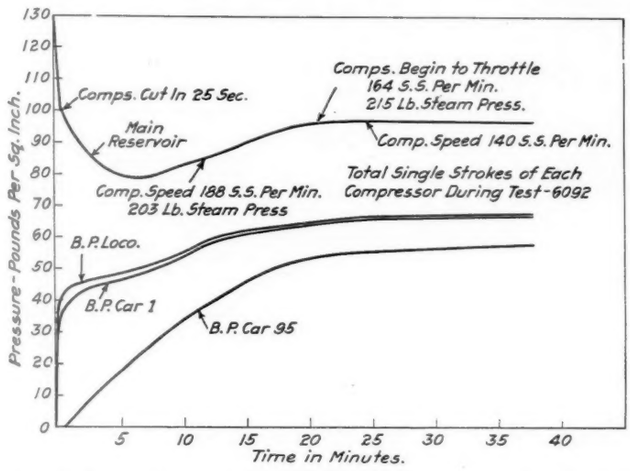

Pressure - Pounds Per Sq. Inch.
Time in Minutes.
Comps. Cut In 25 Sec.
Comps. Begin to Throttle
164 S.S. Per Min.
215 Lb. Steam Press.
Main Reservoir
Comp. Speed 140 S.S. Per Min.
Total Single Strokes of Each Compressor During Test - 6092
Comp. Speed 188 S.S. Per Min.
203 Lb. Steam Press
B.P. Loco.
B.P. Car 1
B.P. Car 95

Fig. 1—Time of Charging Train with Leakage of 41 Cu. Ft. per Minute; Brake Valve in Running Position

Following these tests the yard plant apparatus was reconnected to the train and three tests made to show the time required to charge the train from atmosphere to 70 lb. pressure on the head end from the yard plant at 80 lb. pressure through the orifice by three different methods. The total train leakage was 35 cu. ft. of free air per minute with 70 lb. pressure on car 1 and the leaks uniformly distributed.

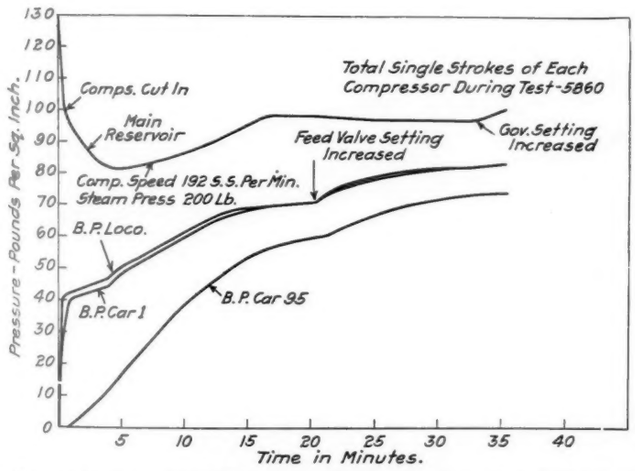

Pressure - Pounds Per Sq. Inch.
Time in Minutes.
Total Single Strokes of Each Compressor During Test - 5860
Comps. Cut In
Main Reservoir
Feed Valve Setting Increased
Gov. Setting Increased
Comp. Speed 192 S.S. Per Min.
Steam Press 200 Lb.
B.P. Loco.
B.P. Car 1
B.P. Car 95

Fig. 2—Time of Charging Train with Leakage of 35 Cu. Ft. per Minute; Brake Valve in Running Position

The first of these tests was made with yard plant supply pressure held at 80 lb. and a by-pass around the charging orifice wide open. During the test this by-pass was gradually closed so as to hold the brake pipe pressure on car 1 constantly at 70 lb. until just as the train became fully charged the by-pass was completely closed. This method gave the shortest possible time in which the train could be charged by the yard plant without overcharging the head end and it will serve as an example of the proper manner for operating such apparatus when measuring total train leakage. If for example, when testing a train the pressure on the head end cannot be maintained at 70 lb. with the by-pass completely closed, it will indicate that the total leakage is more than 35 cu. ft. of free air per minute, and should be reduced, whereas if with the by-pass closed the pressure on the head end can be maintained or built up higher than 70 lb. it will indicate that the total leakage is equal to or less than the maximum permissible amount and the train can be allowed to proceed. The second test was made by charging up in the same manner as in the first test except that when the pressure on car 1 reaches 70 lb. the by-pass around the charging orifice was closed instantly instead of gradually. The third test was made by charging up through the orifice with the by-pass around it closed at all times. During all of the three of these tests the brake pipe pressures on cars 1 and 95, the auxiliary reservoir pressure on car 1 and the Toolometer readings were observed at various time intervals.

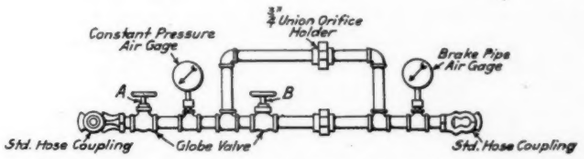


Fig. 3—Orifice Apparatus for Charging Trains in Yards

Following the first charging test described, two ordinary brake pipe leakage tests were made, one with the brake equipments cut in and the other with all but 12 brake equipments cut out. It was not possible to cut out these 12 equipments on account of leakage cocks and gages in use. A Toolometer reading of the air required to maintain the leakage with the equipments cut out was also taken. These tests served to compare the Toolometer reading with the ordinary brake pipe leakage test method of measuring leakage with the effect of auxiliary reservoir leaks substantially eliminated. The resultant calculations showed the leakage according to the ordinary leakage test to be 32.7 cu. ft. of free air per minute and according to the Toolometer reading 33.4 cu. ft. of free air per minute. The difference is remarkably small and could be accounted for by the possible existence of small leaks in the auxiliary reservoirs of the 12 equipments not cut out.

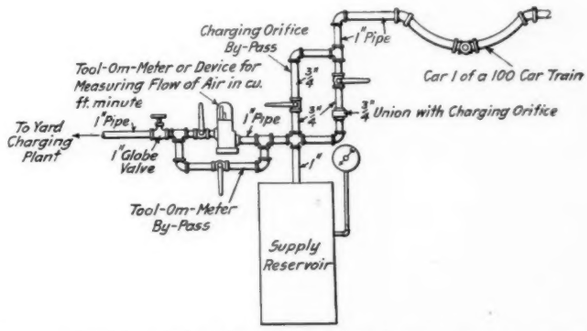

Charging Orifice By-Pass
1" Pipe
Car 1 of a 100 Car Train
Tool-Om-Meter or Device for Measuring Flow of Air in cu. ft. minute
¾" Union with Charging Orifice
To Yard Charging Plant
1" Globe Valve
Tool-Om-Meter By-Pass
Supply Reservoir

Fig. 4—Apparatus with Which the Orifice Leakage Tests were Made

The ordinary leakage tests were made by overcharging the train so that the head end was at approximately 85 lbs. A 20-lb. reduction at the brake valve was then made and the train allowed to leak down. Beginning at 60 lb., simultaneous readings of brake pipe readings of brake pipe leakage on the locomotive, car 1 and car 95 were obtained at 10-second intervals. This test was made first with all triple valves cut in and then repeated with all triple valves cut out except those on the twelve cars fitted with gages and leakage cocks. In the first case the pressure drop during the

first minute was 7 lb. on the locomotive, 7.5 lb. on car 1 and 7 lb. on car 95; in the second case the pressure drop was 7.5 lb. on the locomotive, 8 lb. on car 1 and 7.5 lb on car 95. Under the conditions of the second of these two tests the Toolometer showed that 33.4 cu. ft. of free air per minute were required to supply leakage, where 41 cu. ft. were required when all the equipments were cut in. The calculated volume of free air of 32.7 cu. ft. per minute was determined on the basis of the pressure drop recorded in this test.

Fig. 1 shows a graphic record of the results of the pump up test in which an empty train was charged to a pressure of 70 lb. on car 1 against a leakage adjusted to 41 cu. ft. of free air per minute on the fully charged train. The compressor equipment consisted of two 9½-in. air pumps operating on 200 lb. steam pressure, with a duplex main reservoir control of 100 lb. and 130 lb. The train was charged with the brake valve in running position.

Fig. 2 was obtained under the same conditions except that the leakage had been reduced to 35 cu. ft. of free air per minute on the fully charged train. In this test the pressure on car 1 was raised to 85 lb. by raising the feed valve setting.

CONCLUSIONS

The ordinary method of measuring brake pipe leakage on trains is not an accurate check on the total amount of train leakage which the compressor on the locomotive must be able to supply if the train is to be handled successfully.

The method suggested for measuring the total leakage by charging the train through an orifice supplied with a fixed pressure does not afford an accurate means of measuring the total train leakage.

If the maximum permissible amount of train leakage is fixed upon, an orifice size can be determined which when supplied with a constant pressure of 80 lb. from a yard plant will just supply the necessary amount of air to the train to maintain the leakage specified.

Such a charging orifice can conveniently be used while charging a train from the yard plant and it will afford a means for accurately determining whether the total leakage of the train is less than, equal to or greater than the maximum permissible leakage.

The best method of manipulating the charging erifice test apparatus, a proposed form of which is shown in Fig. 3, is for the operator to start the test with the by-pass around the orifice open and then as the train charges gradually close this by-pass so as to maintain 70 lb. brake pipe pressure on the first car of the train. This method will accomplish the charging of the train in a minimum of time and avoid any objectionable overcharging.

The foregoing seems to point out the necessity of a better brake maintenance and a better initial installation of the brake apparatus; this has particular reference to securing the reservoirs and cylinders to the car body and proper clamping of the brake pipe. A large majority of the leaks are due to loose reservoirs, cylinders, and brake pipes. Tightening of the unions when these parts are loose only affords temporary relief. More attention should be paid to hose couplings when mounting hose, as many are found that do not gage and when coupled, leak.

A recent investigation of 12 trains, varying from 80 to 114 cars per train, showed a loss of air from 30 per cent to 93 per cent of the compressor capacity. Losses of this kind are not only expensive in compressor maintenance and coal consumption, but cause serious delays to traffic.

The writer wishes to express his appreciation to the Westinghouse Air Brake Company for assistance in conducting the tests and compiling the test data.

DISCUSSION

The discussion indicated a general appreciation of the seriousness of train leakage on roads handling trains approaching and often exceeding 100 cars. Not only has the difficulty of maintaining and supplying adequate train pipe pressure been increased by the handling of long trains, but heavy cars and the severe shocks which result from rough handling have greatly added to the difficulties of maintaining a reasonably tight train line. Under these conditions, reservoirs inadequately secured and pipes not sufficiently clamped, are soon jarred loose and excessive leaks result. The need of co-operation between the maintenance forces and designers, in order that the location of the air brake equipment and the methods of securing it to the car may be such that it will adequately perform its functions, was pointed out.

The opinion was expressed that the time has arrived when a complete system of piping designed especially to meet the requirements of locomotive and car service is needed. The piping now in use is not essentially different from that used for gas and water in our houses under the most favorable conditions so far as external stresses are concerned; it is an adaptation of existing facilities not well suited to meet the entirely different conditions under which they must operate. Attention was called to the frequency with which a poorly designed piping layout is found on hopper bottom cars where the reservoir is often placed directly over the train pipe with a branch pipe not over 12 in. or 14 in. long, and this made up largely of elbows and couplings. With the train pipe located between the center sills it is often impossible to locate, much less attend to repairs to a leak when it is located.

One of the most prolific causes of train leaks is inadequate reservoir fastenings which permit the reservoir to become loose under the stresses imposed in service. It is usually the practice to leave the stopping of leaks until trains have been made up and tested in the yards. Under such conditions time does not permit of doing more than patching up unions and other similar repairs, the result being that leaks caused by loose reservoirs are immediately opened up again as soon as the train is in motion. It was suggested that such repairs might well be made on the house track while cars are being loaded, at which time the leaks could be permanently stopped and delays in despatching trains materially reduced.

HOT BOXES ON FREIGHT CARS

BY "OLD RAILROADER"

Hot boxes are caused by one or the other of the nine following causes:

First.—Poor lining used in filling the brasses. Too much lead is used in the composition and the brass is not properly cleaned before truing it.

Second.—Journal keys not fitting properly in the box or on the brass. There should be a certain allowance made in all keys so that the weight on the journal is properly distributed. If not, that part of journal that has the greatest weight will heat and cause trouble.

Third.—Arch bars not in proper alinement. This defect has more to do with heated journals and hot boxes than is realized. One cause for improper alinement is derailments. All derailed trucks should be carefully examined.

Fourth.—Improper loading. If from any cause excessive loading is placed on any one journal, due either to the side bearing clearance being too small, or shifting of the lading, or improperly loaded car, heated bearings will result.

Fifth.—Flat spots on wheels. This condition also has been known to cause heated journals as the pounding will cause the lining of the brass to be crushed out.

Sixth.—Lack of lubrication. Sometimes the waste or packing is not properly prepared and in the majority of cases the proper time is not allowed for the oil to saturate through the waste.

Seventh.—Defective packing. This condition is brought about by the desire to save all old packing for reuse after it has been improperly sorted.

Eighth.—Rough journals. This condition causes more hot brasses than any of the other causes. This should be carefully watched by every one. Any journal that has been hot and cooled with water by a train crew should not be allowed to leave yard until another pair of wheels be applied

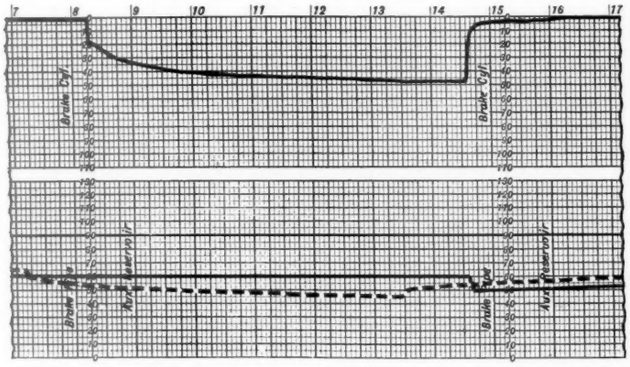
Ninth.—Open boxes. Those that have no dust guards or are allowed to run without lids, or improperly fitting lids, cause heated journals due to the grit, etc., that gets into boxes, particularly during the summer months.

After 39 years of railroad work the writer is of the opinion that if a good clear manual of instructions could be compiled, so that the box packer and car repair man would know how to properly pack a journal box it would prove valuable.

AUTOMATIC STRAIGHT AIR BRAKE

A New System for Passenger and Freight Equipment Which Has Many Interesting Features of Operation

A NEW air brake system has recently been perfected by the Automatic Straight Air Brake Company, 14 Wall street, New York, for freight and passenger equipment, which contains many new and interesting features of operation. The purposes of this brake are to give rapid serial action to the brakes throughout a train, to maintain a constant and uniform brake cylinder pressure regardless of piston travel, to permit a variation of brake cylinder pressure at the will of the engineman, to provide a proper and



Service Application of the Brakes with Quick Release

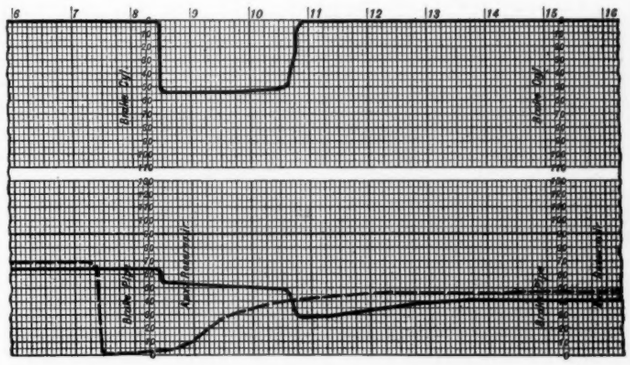
The top curve represents brake cylinder pressure, the full line in the lower set of curves represents the pressure in the auxiliary reservoir, while the dash line shows the pressure in the brake pipe. The pen indicating the brake pipe pressure is set a distance of one minute back of the pens indicating the brake cylinder and auxiliary reservoir pressures. The above curves show that as the brake pipe pressure is reduced, the brake cylinder pressure of 20 lb. is obtained at once, which is increased on further reduction of the brake pipe pressure to about 50 lb., the pressure in the auxiliary reservoir remaining constant. With the building up of the brake pipe pressure, a small amount of air from the auxiliary reservoir is released to the brake pipe to hasten the release, the rapidity of release being indicated by the brake cylinder curve.

quick release of the brakes for any brake pipe reduction, to provide for a full emergency application of the brakes at any time, to provide a graduated or quick release as desired, and to provide an economical use of air.

This brake system provides a quick action passenger brake, one brake cylinder being used for a service application and two brake cylinders for an emergency application of the brakes. As the triple valve is capable of compensating for varying volumes in brake cylinders, a second brake cylinder can be added to existing freight equipment for empty and load braking, the braking system retaining at the same time all of its functions and principles.

The brake is operated by the engineman in the same manner as is common with present day practice. The equipment can be used interchangeably with other existing equipment. The main features of this new brake are found in an entirely new triple valve with its auxiliary, service and quick action reservoirs. The auxiliary reservoir is of the same volume as that ordinarily used, the service reservoir has a volume of 2,100 cu. in. and the quick action reservoir a volume of 200 cu. in., which with an additional volume due to brake pipe connections, gives an increase in volume of about 2,300 cu. in. per car on 10-in. freight equipment. The service reservoir is used for service and emergency applications of the brake, the auxiliary reservoir is used for an emergency application of the brake and for a quick release of the brake in contrast to a graduated release. The quick action reservoir is used only in making an emergency application of the brakes. The triple valve is made up of disk valves and diaphragms, no slide valves or pistons being used.

Due to its construction and operation this brake has the characteristics of a straight air brake and at the same time is automatically operated. The straight air features are obtained through the fact that with every application of the brakes air is exhausted from the brake pipe under each car. In case of a service application air from the brake pipe is exhausted into the brake cylinder and in case of an emergency application the air from the brake pipe is exhausted to the atmosphere. In the first case, the air is not



Emergency Application of the Brakes

In this case the brake pipe pressure was reduced to zero, giving an instantaneous brake cylinder pressure of 55 lb. with an accompanying decrease in auxiliary reservoir pressure. At release more air is taken from the auxiliary reservoir to aid the release as described under the quick release operations, the brake being released in about 10 seconds. Due to the construction of the triple valve, the auxiliary reservoir pressure is then raised, through the charging port, with the brake pipe pressure, the difference in the amount being due to the spring used on the auxiliary reservoir diaphragm. This record was obtained from car 61 in the 100-car test rack described in the text.

wasted but is used to build up the pressure in the brake cylinder in conjunction with the supply of air from the service reservoir. In both cases the rapidity of serial action is increased due to the fact that the brake pipe pressure is reduced locally at each car.

The design of the triple valve is such that when fully charged the pressure in the brake pipe acting on the under-

side of a diaphragm balances the pressure in the auxiliary reservoir acting on the upper side. A reduction in brake pipe pressure causes the auxiliary reservoir pressure to force the diaphragm downward admitting air to the brake cylinder from the brake pipe and service reservoir. The air in the brake cylinder acts on a second diaphragm which is connected to the first and which is of one-half its area. The pressure in the auxiliary reservoir remains unbalanced forcing the diaphragm down until the force exerted by the brake pipe pressure on the underside of this diaphragm plus force exerted by the air in the brake cylinder on its diaphragm exceeds it. The diaphragm will then be raised and the supply of air to the brake cylinder cut off. Thus it will be seen that the brake cylinder pressure bears a direct relation to the brake pipe reduction and is not affected by the brake piston travel or brake cylinder leakage. By regulating the brake pipe pressure, any brake cylinder pressure may be obtained.

Each triple valve is provided with means for making a graduated or quick release. The graduated release is obtained by building up the brake pipe pressure from the locomotive. The quick release feature is obtained by raising the brake pipe pressure three pounds, at which time auxiliary reservoir air is released to the brake pipe under each car.

Interesting features of this brake are that service applications can be varied at the will of the engineman by his regulation of the brake pipe pressure without the necessity of releasing the brakes before a re-application when operating with the graduated release, and the fact that the auxiliary reservoir maintains a reserve supply for a full emergency application, regardless of the number of service applications made. The triple valve is of such a design that after a train has once been charged, an emergency application will automatically be made if for any reason the brake pipe pressure should be reduced to zero.

This company has been making a series of exhibition tests on a 100-car test rack composed of 51 A S A brake equipments and 49 brake equipments in common use today, which were attended by between 200 and 300 railroad representatives. The equipments have been distributed in multiples of five throughout the train, that is, five A S A equipments, five other equipments, etc., with the hundredth car being an A S A equipment. These tests have shown that the time between the application of the brakes on the first car and the hundredth car with a service application is about 14 seconds, and with an emergency application about 8 seconds. Records taken on trainagraphs of a service application with quick release, a service application with graduated release and an emergency application are shown in the illustrations.

The following, to be used in connection with a diagrammatic illustration of the triple valve, gives an outline of the operation of the A S A triple valve:

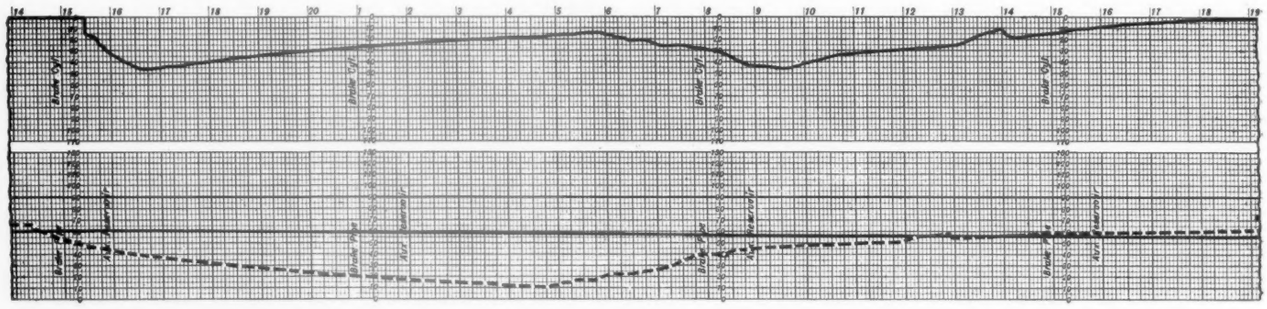
CHARGING THE TRIPLE VALVE

The air from brake line 1 passes into chamber 2 of the service section and into pipe 1a leading to the emergency section.

Service Section.—The air pressure in chamber 2 acts on the diaphragm 3, raising it until the valve 9 is uncovered. This permits the air to pass through a small port 18 into chamber 4 and the auxiliary reservoir. The spring 7c exerts a force equivalent to three pounds of air and as soon as the pressure in chamber 4 is within three pounds of the pressure in chamber 2 the valve 9 will close.

The air from chamber 2 also passes through port 12 into the hollow stem 6 past the non-return valve 32a into chamber 30 and on top of valve 32.

From chamber 2 the air also passes through the passage 42 to chamber 40a, where it raises the diaphragm 43 which lifts the left hand end of lever 65, opening valves 71 and 55. The air passing through valve 71 passes through pipe 68, past the maintaining valve, when open, to pipe 41c and on top of the valve 77. The air passing through valve 55 passes through pipe 10 to chamber 85 of the change-over valve and from there through valve 95 and hollow stem 94 to the service reservoir. From chamber 85 the air also passes up through ports 14 into chamber 90 above the diaphragm 88.



Performance of the Brake Under Conditions of a Gradually Depleted Brake Pipe, Showing the Performance Under Graduated Release

With the reduction in brake pipe pressure, the brake cylinder pressure increases until both are about 45 lb. From that point a further reduction in brake pipe pressure will cause a reduction in brake cylinder pressure, and in no case below this point will the brake cylinder pressure be less than the brake pipe pressure. A prolonged reduction of the brake pipe pressure was made purposely to disclose this fact. As the brake pipe pressure increases, the brake cylinder pressure increases until a pressure of 45 lb. is obtained in both the brake cylinder and brake pipe. From that point on, the graduated release goes into operation and with a further increase in brake pipe pressure, the brake cylinder pressure will be reduced. It will be noted that the auxiliary reservoir pressure has not changed.

The air passing through valve 55 also passes to chamber 47 above the diaphragm 43. As the pressure in chamber 47 plus the pressure caused by spring 50 equalizes with the pressure in chamber 40a, the diaphragm 43 will be depressed. This allows the valves 71 and 55 to be closed by their respective springs.

Emergency Section.—The air in pipe 1a passes to chamber 39a past the clearance 44 into chamber 40 above the diaphragm 39, keeping the valves 60 and 60a closed. This pressure also acts on valve 46, keeping it closed. From chamber 39a the air also passes through the port 68 to the chamber 81, then down through port 74 to the quick action reservoir.

SERVICE BRAKE APPLICATION

The service application of the brake is made in the usual way by reducing the brake pipe pressure. This reduces the pressure in chamber 2 of the service section and pipe 1a leading to the emergency section.

Service Section.—The reduction in pressure in chamber 2 permits the pressure in the auxiliary reservoir and chamber 4 to depress the diaphragm 3. This lowers the valve stem 6 and with it diaphragm 29, valve cage 28 and valve 32 and with it valve 35, which is rigidly connected to 32. As valve 35 seats on the cage 135, the opening between the brake cylinder and chamber 25 with the atmosphere is closed. The cage 28 drops away from the valve 32, permitting the air

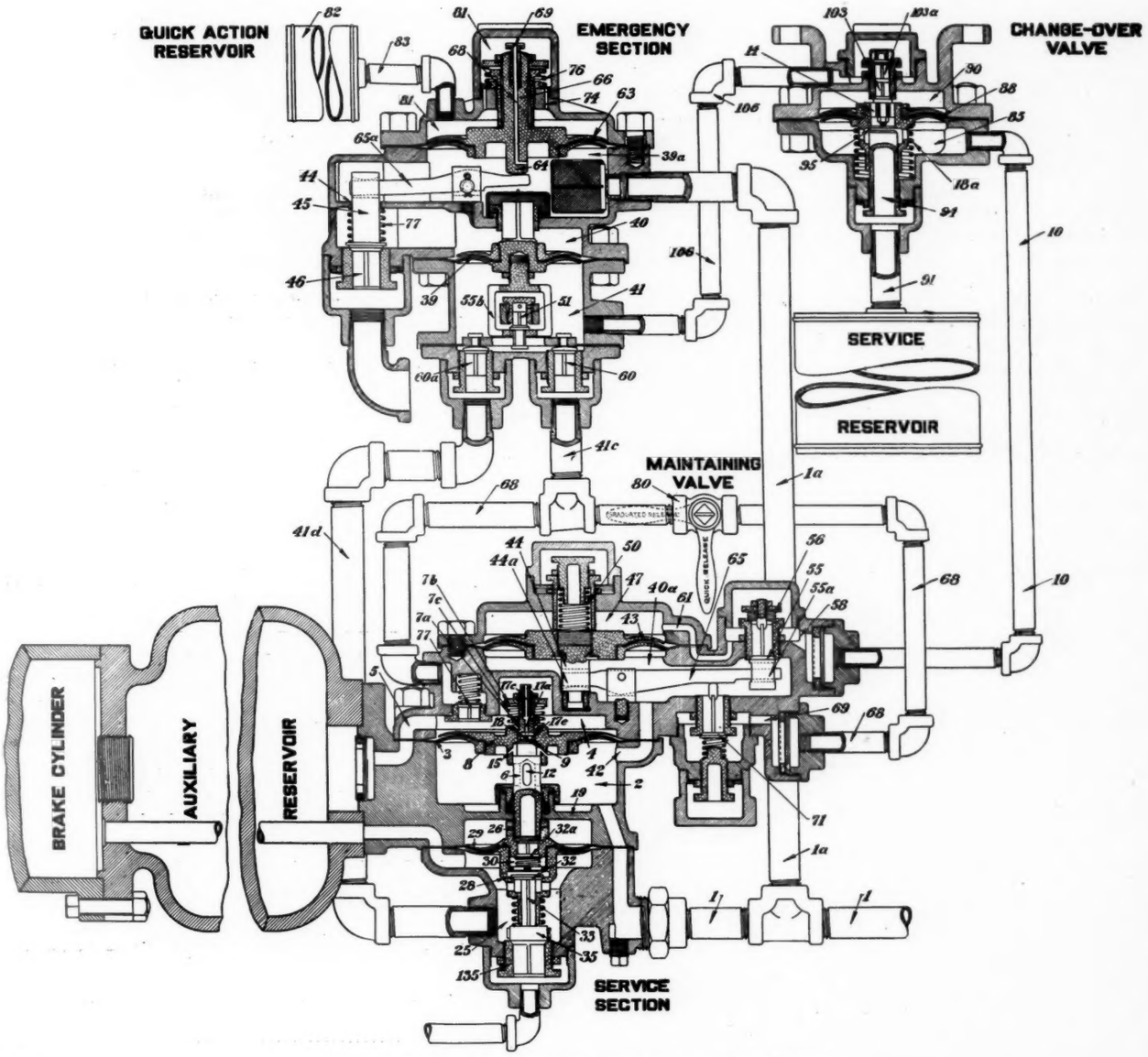
in chamber 30 to pass into chamber 25, which is connected directly to the brake cylinder, thus charging the cylinder. Air also flows from chamber 40a and from the service reservoir through the valve 95, pipe 10 and valve 55 to chamber 2, thus augmenting the air supply in chamber 2 which passes to the brake cylinder.

As the force exerted by the air pressure in chamber 25 on the diaphragm 29 plus the force exerted by the air pressure in chamber 2 on diaphragm 3 exceeds the force exerted by the air pressure in chamber 4 plus the pressure of spring 7c, the spindle 6 will be raised with the valve cage 28, seating valve 32, cutting off the supply of air to the brake cylinder. Since the area of diaphragm 29 is about one-half that of diaphragm 3, the pressure in chamber 25 to provide equilibrium will be about twice the reduction made in chamber 2. If for any reason the pressure should leak off from the brake cylinder, the forces will again become unbalanced and valve 32 will again be opened until equilibrium is once more established. In this way the brake cylinder pressure will always remain a certain definite function of the brake pipe for each brake pipe reduction. The air pressure in chamber 47 will be reduced with the pressure above the valve 55, but as it with the spring 50 is greater than the pressure in chamber 40a, the diaphragm 43 will always remain down during the service application of the brake.

Emergency Section.—The reduction of the brake pipe pressure causes a reduction in chambers 39a and 40 without operating any of the parts. The reduction is so gradual that the pressure from 81 will be relieved through passage 69 without operating diaphragm 63.

RELEASING THE BRAKES

Graduated Release.—To obtain the graduated release the maintaining valve 80 is closed, thus cutting out the use of the



Triple Valve for the Automatic Straight Air Brake System

valve 77 and the auxiliary reservoir pressure. With the service section in lap position, that is, with the pressures in chambers 25 and 2 balancing the auxiliary pressure in chamber 4, by raising the brake pipe pressure and the pressure in chamber 2, diaphragm 3 and with it valve stem 6, diaphragm 29 and valve cage 28 will be raised, this will lift valve 35 from its seat, permitting the air from the brake cylinder to release to the atmosphere until the

pressure in chamber 25 has been reduced sufficiently to re-establish the balance destroyed by the increase in brake pipe pressure. At this time the service section will again move to lap position. In this way the release may be graduated in as many steps as desired, the full release being obtained when the brake pipe pressure has been restored sufficiently to balance the auxiliary reservoir pressure. In case it is desired to reapply the brakes after a partial release has been made, this can be done by simply reducing the brake pipe pressure again.

Quick Release.—To obtain the quick release, the maintaining valve 80 is opened, as shown by the full lines in the illustration. With the increase in pressure in chamber 2, the performance of the service section will be as described above. The pressure in chamber 40a will be built up, raising diaphragm 43 and with it the left hand end of lever 65, which will open valve 71 a short time ahead of valve 55 on account of the clearance between the right hand end of the lever and the bottom of the slot in the valve body 55a. Opening valve 71 permits air from the auxiliary reservoir which is at a higher pressure than the air in chamber 40a to pass forward through valve 77, pipe 68, through valve 71 into chamber 40a, thus rapidly increasing the pressure in chamber 2 and insuring a quick release of the air pressure from the brake cylinder. With the brakes released the system will be recharged as described above.

EMERGENCY APPLICATION

There are no movements of the parts in the emergency section during charging, service, lap, and release operations. The moderate service brake pipe reductions permit the air to flow from the quick action reservoir 82 to the train pipe through the restriction screw 69 at the same rate as the brake pipe reduction is taking place, thereby maintaining equal pressures on both sides of diaphragm 63.

To obtain an emergency application, a rapid and prolonged brake pipe reduction is made. This causes the service section to assume service position quickly and reduces the pressure in chamber 39a of the emergency section faster than the pressure in the quick action reservoir 82 can be reduced through the restriction screw 69.

The pressure in chamber 81 above diaphragm 63 will then be higher than the pressure in chamber 39a, with the result that diaphragm 63 will be forced down. Stem 64, moving with the diaphragm, will depress the inner end of the fulcrum lever 65a and the left end will be raised, thereby raising the brake pipe exhaust valve 46, and venting the brake pipe pressure direct to the atmosphere.

The sudden reduction of brake pipe pressure quickly reduces the pressure in chamber 40a of the service section. thereby opening the valve 55 and causing a corresponding reduction in chamber 85 of the change-over valve through pipe 10. The pressure in chamber 85 of the change-over valve will then be reduced faster than the service reservoir pressure can flow through the restricted opening of valve 95, and as the upper chamber 90 is in direct communication with the service reservoir through ports 14, the high service reservoir pressure above diaphagm 88 forces the diaphragm down. This movement closes valve 95 and opens valve 103. The closing of valve 95 seals the service reservoir from the brake pipe, and the opening of valve 103 releases the service reservoir air to chamber 41 of the emergency section through valve 103a and pipe 106.

This action occurs instantly and diaphragm 39 is raised by the decreasing brake pipe pressure in chamber 40, and the increasing service reservoir pressure in chamber 41, thereby raising the yoke 55b. The upward movement of the yoke closes vent valve 51 and opens valves 60 and 60a. The opening of valve 60 releases the auxiliary reservoir to chamber 41 through pipe 41c. From chamber 41 the air from both the service and auxiliary reservoirs flows past valve 60a through pipe 41d to chamber 25 and the brake cylinder.

The operation of the parts just described quickly reduces the brake pipe pressure, and assures a quick and positive emergency application of the brakes throughout the train.

Valve 46 will remain open until the entire brake pipe pressure has been reduced sufficiently to assure an emergency application. The length of time depends upon the time required to vent the pressure in chambers 81 and 82, above diaphragm 63, to chamber 39a. This is determined by the size of the opening through the restriction screw 69. When the pressure in chamber 81 has been reduced to an equality with that in chamber 39a, spring 76 raises diaphragm 63 and spring 77 closes valve 46.

A release of the brakes after an emergency application is effected by raising the brake pipe pressure above the pressure in chamber 4, which, in emergency, is equal to brake cylinder pressure. When the pressure in the brake pipe and in chambers 2 of the service section and 40 of the emergency section is raised above the equalized pressure in chambers 4 and 41, diaphragm 39 will be depressed, closing valves 60 and 60a and opening vent valve 51. This releases the pressure in chamber 41 to the atmosphere, and the upward movement of diaphragm 3 opens exhaust valve 35, releasing the brake cylinder pressure to the atmosphere.

When the brake pipe pressure has been raised in chamber 85 of the change-over valve above the service reservoir pressure in chamber 90, diaphragm 88 will be raised to its normal position in which it is held by spring 18, and the service reservoir will again be charged.

Should an emergency application be desired following a service application, and service reservoir and brake pipe pressures are below the emergency brake cylinder pressure, valve 103a will prevent the emergency brake cylinder pressure from returning to the service reservoir.

CALCULATING HEIGHT OF GRAIN LINE FOR BOX CARS

BY THOMAS R. WILLIAMS
Mechanical Draftsman, Northern Pacific, St. Paul, Minn.

The purpose of this article is to show the method of calculating the height of grain lines in box cars and to reduce as much as possible the calculations to constants which can be taken from a table.

The height to which a car may be loaded with grain depends on the length and width of car, the lading capacity of car in pounds, and the weight per bushel of various kinds of grain.

Let H = Height of grain line in inches
L = Length of car in inches
W = Width of car in inches
C = Lading capacity in pounds
Y = Weight per bushel of grain

The weights per bushel for various kinds of grain are as follows:

Wheat	60 lb.
Corn, rye or flax	56 lb.
Barley	48 lb.
Oats	32 lb.

The number of cubic inches in a bushel is 2150.42. Then the bushels in car for each inch of height is:

$$\frac{\frac{L \times W}{2150.42}}{}$$

$$\text{and } H = \frac{C}{\frac{L \times W}{2150.42} \times Y} = \frac{2150.42 \times C}{L \times W \times Y}$$

In this formula all of the factors except the length and width of the car can be reduced to constants for the various

grains and car capacity. These constants are shown in the following table:

Grain	Weight per bu. (lb.)	Constants 40,000 capacity	50,000 capacity	60,000 capacity	70,000 capacity	80,000 capacity	100,000 capacity
Wheat.	60	1,433,613	1,792,017	2,150,420	2,508,823	2,867,227	3,584,033
Corn, rye, flax..	56	1,536,014	1,920,018	2,304,021	2,688,025	3,072,028	3,840,035
Barley.	48	1,792,017	2,240,020	2,688,025	3,136,029	3,584,033	4,480,042
Oats...	32	2,688,025	3,360,030	4,032,038	4,704,044	5,376,050	6,720,063

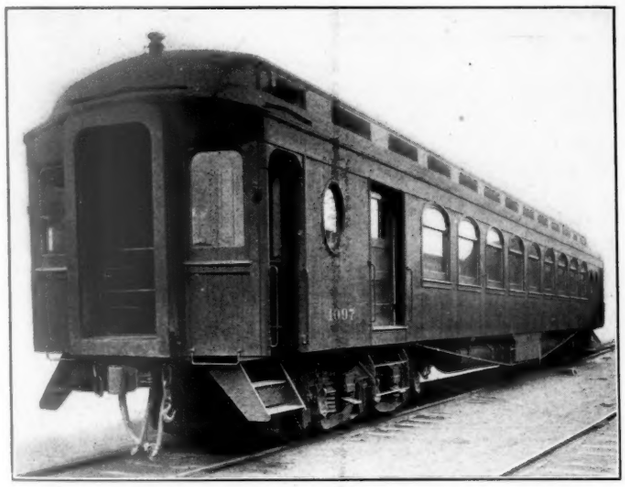
The simplified formula then becomes:

$$H = \frac{\text{constant}}{L \times W}$$

By keeping this table for reference it will be an easy matter to determine the grain line heights.

HOSPITAL CAR FOR THE ERIE

To meet the demands of the Government for appropriate cars in which to transport sick or wounded soldiers, the Erie has remodeled a 70-ft. steel underframe parlor car, s shown in the illustrations, providing it with 28 adjustable cots placed in two tiers. The car is provided with a re-eiving and supply room 10-ft. 8½ inches long, with a



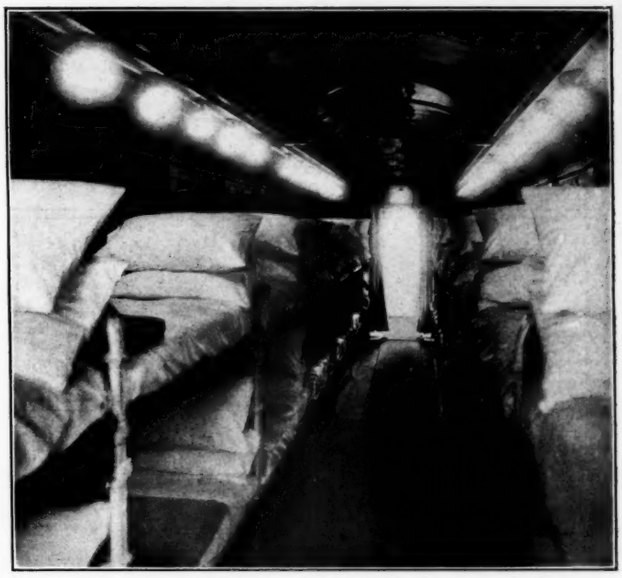
Erie Hospital Car

sliding door at each side, at one end of the car. At the other end is a small rest room for the nurses, provided with a sofa and lavatory. The main portion of the car is about 50-ft. 6 inches long and contains seven two story cots on each side.

The two story cots are of a new design furnished by Frank A. Hall & Sons of New York. The springs of these cots are adjustable to any desired position for a patient's back or legs. This is clearly shown by a sketch on the floor plan of the car. The cots are finished in white enamel.

The supply room contains a fireless cooker, drinking water tank, wash basin and supply locker. The annunciator on which calls from any part of the car are indicated is also located here. It is separated from the main compartment by heavy rubber curtains.

The car is equipped with electric lights the lighting fixtures being located on the side decks. Emergency



Interior View of the Erie Hospital Car

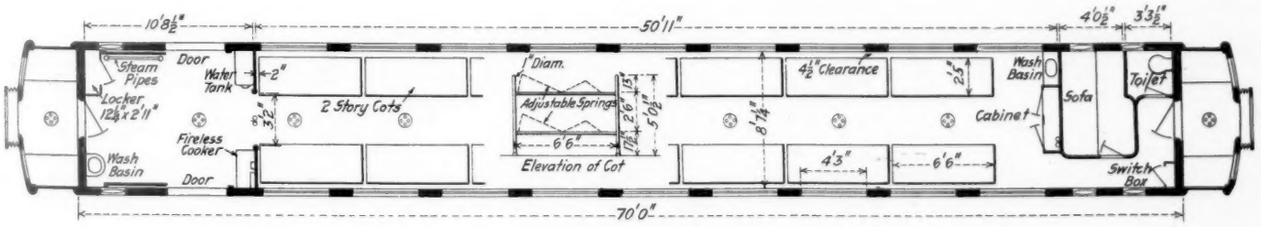
lights are provided by Pintsch gas lamps located in the center of the upper deck.

The interior finish of the new hospital car is a light gray which is easy to the eyes.

NEW FLOOR PLANS FOR POSTAL CARS

A modification of plans for the construction of postal cars has been approved and issued as an optional standard by the Division of Railway Mail Service of the Post Office Department. The changes have been made with a view to providing designs that can be easily converted from one standard length to another when service conditions make it necessary to increase or decrease the space devoted to handling mail. The cost of maintaining postal cars conforming to the requirements of the Post Office Department should be materially lessened by this arrangement.

The new plans consist of minor modifications of existing standards which will make it possible to convert a 60-ft. postal car into a 30-ft. apartment car, or change a 30-ft.

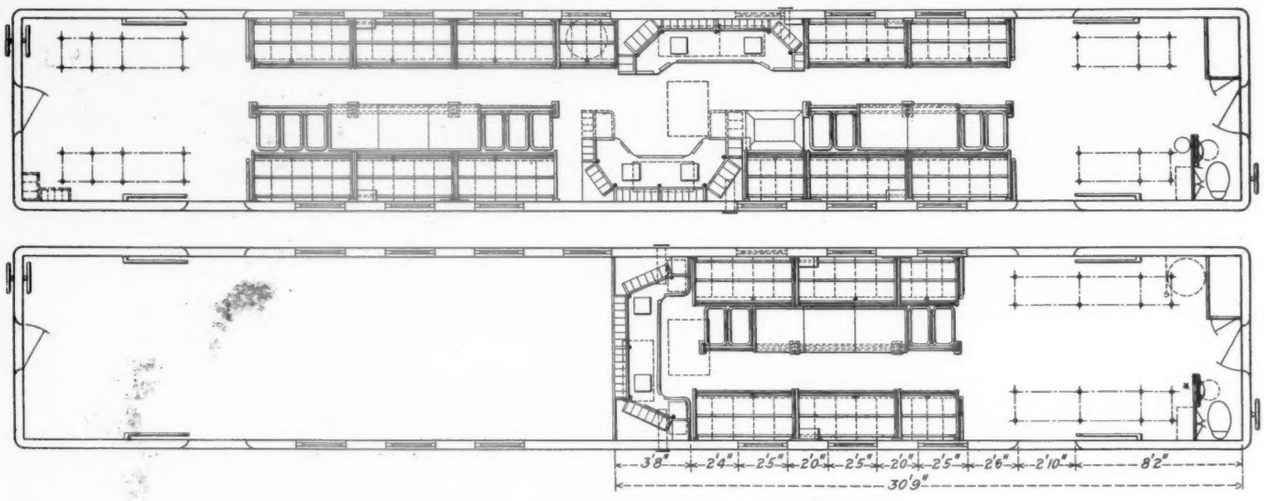


Floor Plan of Erie Hospital Car

apartment car into one having a 15-ft. apartment. In case it is desired to return to the original arrangement it can be done at slight expense. These changes have been made possible by making the location of the doors and windows common to either size car.

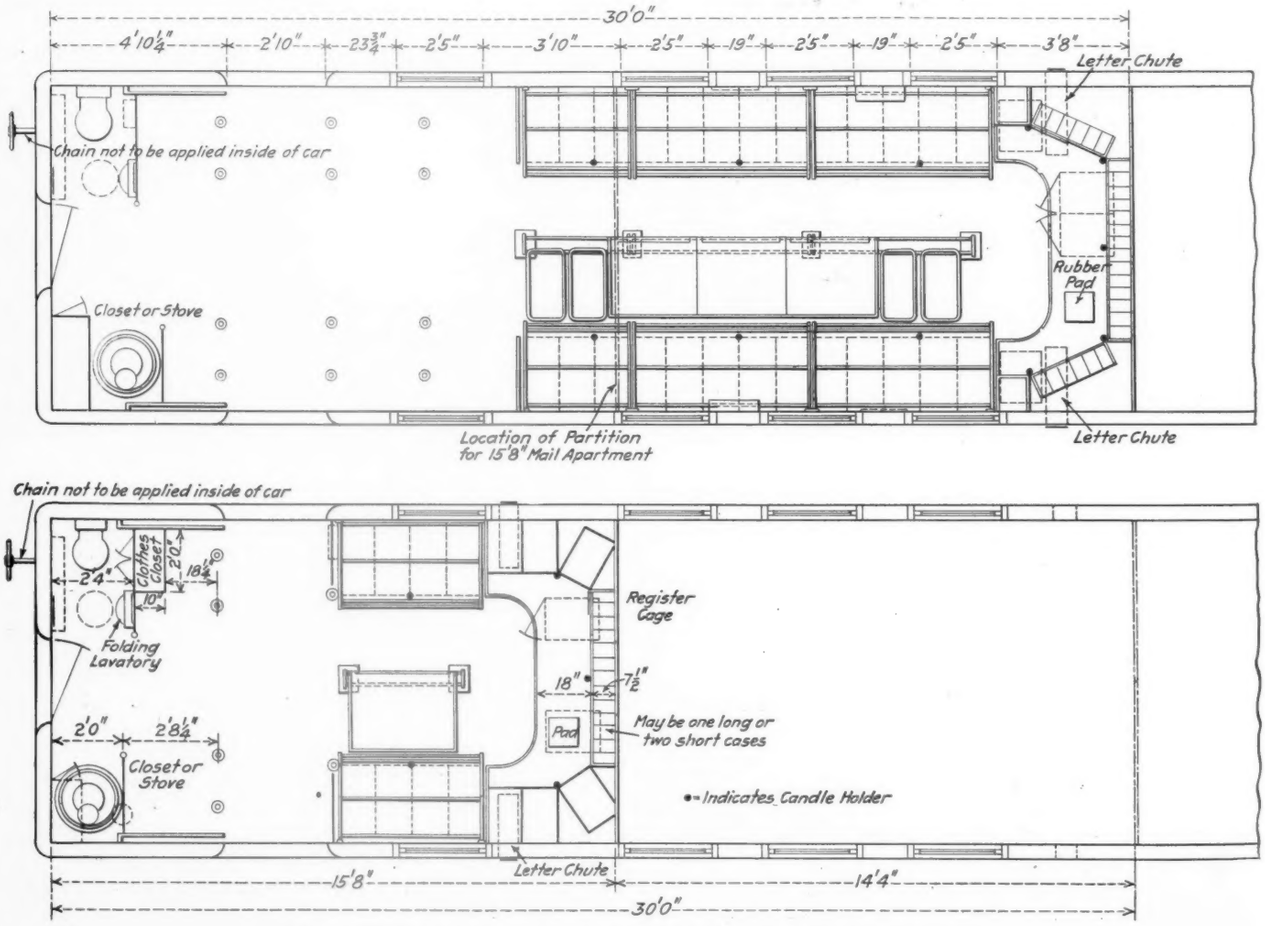
The Post Office Department points out in connection with

these plans that the work of transforming from one length to another may be greatly facilitated by making the interior equipment more nearly portable than is customary at present. Screws and bolts may be used for securing fixtures which are now permanently attached to the car body. It is also suggested that roads building 60-ft. postal cars which may at some future time be changed to 30-ft. apartment cars may make it easy to change one end of the cars into a baggage compartment by framing the side doorways at one end for the company's standard baggage door-opening and filling in with false work to reduce the door openings to 2 ft. 10 in., the standard for postal cars.



Plans for Converting the 60-ft. Mail Car to the 30-ft. Compartment Car

Complete plans for the 15-ft.-30-ft. mail apartment are shown on Railway Mail Service drawing sheet M, while the plans for the 60-ft. mail car convertible to a 30-ft. apartment are shown on sheet N.



New Optional Floor Plans for 15-ft. and 30-ft. Compartment Postal Cars

SHOP PRACTICE

LOCOMOTIVE TERMINAL DELAYS*

BY H. T. BENTLBY
Superintendent of Motive Power and Machinery, Chicago & North Western

While the subject of this paper is Locomotive Terminal Delays, it might just as well be called "Keeping Engines Moving, or How the Round House and Shop Men Are Helping to Win the War." One of the vital needs of the country at this time is a prompt movement of engines from their arrival at the coal shed until they are ready for service again so as to handle properly not only the troops, but also the ammunition, grain, and other commodities that are just as necessary to bring the war to a successful ending as are the boys in the trenches.

I am not going into technical details, but will simply enumerate a few things that help to expedite engine movements at terminals. First of all the round house foreman must be a hustler and a good all around man, one who has the good will of the men. I believe the round house foreman is entitled to more of our consideration than is sometimes given him.

The following are some of the many good investments for a busy round house:

Coaling facilities that will coal engines quickly without spilling coal on the ground to be shoveled into cinder cars or otherwise wasted.

Clinker pits where cinders can be handled with the greatest despatch and the least amount of labor.

Sanding apparatus that will quickly deliver the sand in the box instead of on the boiler and the running board, and so located that the tender can be filled at same time.

Penstocks or water tanks properly situated so that if a number of engines are waiting to be coaled, the last engine in can get water without having to switch all of the others or wait until they are moved up past the penstock. In the case of a busy terminal, a separate penstock for switch engines is a great time saver. All spouts should be large enough so that no unnecessary delay occurs when taking water.

An engine washing device located outside with proper drainage so that water will be carried off to the sewer.

The turntable should be power operated and the tractor house so located that the operator can see the rails at both ends. A recent installation of a large table came to my notice where the operator could not properly see the rails at either end, making it necessary for two men to be employed where only one would have been needed if the house had been properly located.

It is hardly possible under present conditions to get along without having the use of oxy-acetylene and electric welding outfits in a round house. Numerous terminal delays can be saved with these outfits almost every day, especially in bad water territory where firebox and flue troubles are serious. The welding of flues does overcome delays and the extension of this practice should be considered, although we are told, that unless equipped with welding apparatus in the round houses to follow the work up, there may be some difficulty experienced in case of leakage.

Labor saving devices of all sorts never were in such great demand as at present, and the men who were far sighted enough to equip their shops, engine houses, and engines with them are now reaping the benefit.

A portable electric light cluster with a reflector is a great help to a difficult night job; there ought to be one or more in every busy round house. For reducing terminal delays they are a good investment and easily made.

The dropping of wheels to replace driving box brasses and take up lateral motion is a big job, but with proper devices applied to your engine, much terminal delay can be overcome; we have recently had two engines come to the shops for the first time in five years for driving wheels to be removed. During that time, side play was taken up, new brasses applied and tires changed without dropping the wheels.

The hot water washout plant has been in service long enough to fully prove its usefulness in conserving coal, water and time.

The emptying of sand boxes to make repairs to sanders or to get rid of wet sand is the cause of lots of delays and profanity, both of which can be overcome by proper attention in shops by knowing that joints are water tight and using a sander that can be repaired from the outside without the necessity of emptying the box and spilling sand over the machinery.

The retaining of heat in a boiler, where such action can be taken, not only helps overcome delays, but conserves wood and coal, both of which are in great demand. In some tests made a few months ago, it was shown that it took about twice the amount of steam from the blower line to raise steam on an engine when cold, as compared with one with hot water in the boiler. We periodically talk about covering stacks and sometimes do it, but after a while the practice is dropped. We all know that heat, or its equivalent, dollars and cents, can be saved by covering the stack of a hot engine, then why don't we do it?

What delays can be charged up to an inadequate blower system, and why does not someone get up a device that will be effective and more economical? The condensation that takes place in a blower line from the boiler room, around the house and then to the locomotive is simply a waste of coal that some inventive genius should be able to overcome. A blower line is a good condenser, but not a very economical medium for steam raising.

The firing up of locomotives is a job that is done hundreds of times every day, and if any member has a method of doing this more economically and quickly than by the practice of using wood and coal and will tell us about it, we may be able to save some time or a few shovels of coal on each fire.

Men speeding up their work in the shops and round houses, and doing it well are just as much entitled to credit as people in other occupations who are doing their bit for this glorious country of ours.

The drawing office is sometimes responsible for delays in

*Abstract of a paper presented at the Western Railway Club.

round houses, and if the round house foremen were consulted more often by the mechanical engineer, many annoying delays due to poor design or inaccessible parts would be overcome.

It is possible that some of us are still doing some things that are not absolutely necessary, you might call them "frills." A short time ago we held a staff meeting at which this subject was discussed, and decided to postpone some things not detrimental to the service, until a more opportune time.

Engineers can save delays at the terminal by correctly reporting the work that actually needs doing; the work slip that shows a bad pound on the right side, or packing blowing without saying where, or the air pump not working, or

Report of Delays to Engines in Terminal Service

Date_____ From_____ To_____

ENGINE	Arrived	Time Ordered	Departed	Total Delay	CAUSE OF DELAY

Foreman_____

Report for Recording Delays to Locomotives at Terminals

something wrong with the injector, causes lots of unnecessary work looking for a defect that should have been located in service and which in some cases is difficult to find on a dead engine. Coal can also be saved by the engine crew not coming to the clinker pit with a lot of green coal in the fire box, as it is only knocked out and wasted; we cannot afford to waste coal at any time, but now to do so is almost a crime.

The open sided clinker pit with a depressed track for cinder cars is standard with us, but with the present labor shortage it is a question whether there is not something that requires less labor and can handle cinders more economically.

A copy of our "Delays to Engines in Terminal Service" report is shown herewith, from which it will be seen that very little work is required to give information as to the total delay and the cause. The information given in these reports enables the master mechanic to put his finger on irregularities and correct them.

Most of us are able to say what we could do if we had all the improvements we might think necessary, but as it is impossible to get some of those things now, it is up to us to utilize the facilities we have to the best advantage to keep the wheels moving; by getting good results under those conditions we really are bigger and better men than if surrounded with every convenience for turning engines promptly. Difficulties bring out a man's resourcefulness, and the more difficulties successfully overcome, the more valuable is that man to his employers.

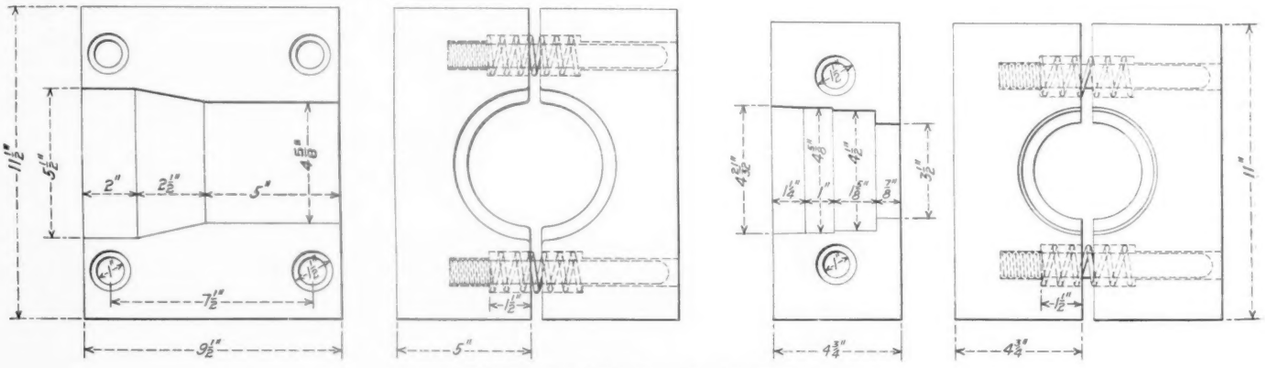
DISCUSSION

Some roads reported that at the present time the average service obtained from locomotives has been increased to 6,000 miles per month in freight service and 9,000 miles per month in passenger service. The practice of filling tenders not quite to the top has been adopted by one road to conserve coal and save labor at the terminal. The necessity for power operated devices for handling cinders was emphasized by one of the speakers, who told of a terminal employing eight laborers on this work, where it was necessary to hire 42 new men in a single month. Several roads were reported to be using stack covers; some are attached to the stack, while others are suspended by chains inside the smoke jack. It has been found necessary to have an opening from 2 in. to 4 in. in diameter in the cover to prevent the engine sweating. As an instance of the special methods used to keep power in service, a foreman at one locomotive terminal told how one-eighth inch was removed from the flanges of an entire set of drivers without dropping the wheels by means of a cutting tool attached to the frame of the locomotive.

STEAM HAMMER DIES FOR SUPERHEATER FLUES

In shops which are not equipped with special machines for handling superheater flues the work of welding them is usually done by expanding the small end of the flue with a roller, swedging the safe end so that it will enter the flue and welding. At the Boone, Iowa, shops of the Chicago & North Western this work has been greatly facilitated by the use of a set of steam hammer dies which are illustrated below.

The dies are guided by the two studs in the upper die and are held about one-half inch apart by the helical springs in the recesses around the studs. The ends of the flues are brought down to the size of the safe end in the dies shown on the left, while those on the right are used to swedge down the safe end so it will enter the flue for a distance of about 1½ in. The superheater flue is heated before the safe end is inserted so that it makes a tight fit after it has cooled. The safe end is then welded to the flue by the oxyacetylene or electric welding process.



Dies for Swedging Superheater Flues

One of the principal advantages of this method lies in the fact that the flue will not give way even though the weld may be defective, due to the considerable overlap of the flue and the safe end.

PLAIN CYLINDER GRINDING WORK

Grinding Machines in the Shop Can Handle Some Classes of Work Better and Quicker Than the Lathe

BY A. B. C.

PLAIN cylindrical grinding machines are now being installed to a limited extent in railway shops and they have been found to be very useful and economical tools. For finishing a number of articles used in locomotive manufacture or repair work, such as cross-head pins, crank pins, piston rods and other parts, it has been found that a better finish can be obtained at less cost than by turning, filing and using emery paper.

Grinding does not appeal to railway people as it does to makers of machine tools and automobiles for the reason that locomotive parts are generally made only in small quantities and the finish need not be equal to that given parts of salable articles, especially where the finish is a selling point. However, as the grinder has proven an economical machine in most branches of manufacture, it will no doubt come to its own in railway work.

Some of the early attempts at grinding in railway shops were not entirely satisfactory due to the fact that the machines were too light and that an improper grade of grinding wheels was used. Later experience has indicated that plain grinding machines for railway work must be heavy and designed so that metal may be rapidly removed, and that the grinding wheels must be of proper grade and grain in order to cut properly and quickly and give the material the finish desired. Recent developments in grinding wheels and appliances for truing them have shown that the same wheel can be used to cut or remove the metal rapidly from any of the various locomotive parts and, after the wheel has been quickly trued with the diamond, satisfactorily finish it with generally superior results than can be obtained by methods where grinding machines are not employed. The experience on universal tool room grinders which are common in all shops does not apply to plain grinders for locomotive parts, the tool room grinder being a small machine and intended only for taking light cuts, whereas for locomotive parts a machine capable of quickly removing metal and producing a smooth finish is essential.

The plain grinding machine that can be recommended for locomotive parts should have ample weight and strength to run grinding wheels with a face of from 1½ in. to 2 in., to their limit. Such a machine will absorb 10 to 15 hp. With some of the heavier plain cylindrical grinders one to two cubic inches of metal can be removed a minute, and with the same wheel properly trued or dressed, a very satisfactory finish can be obtained. The plain machine made by a number of concerns known as 12-in. by 36-in. size is very satisfactory for all work not over 36 in. long and having a diameter up to about 10 in. This machine can be used for crank pins, knuckle pins, crosshead pins, link motion pins and practically all locomotive parts where a running finish is necessary, excepting valve rods, piston rods and axles. This size has ample strength to cut rapidly and produce a good finish. Smaller machines are liable to fall short of requirements and be disappointing. It should be remembered that a grinding wheel is only a circular cutter having a multitude of cutting points. If the machine is strong and the work well supported, the wheel will cut rapidly, but if the machine is weak or the work not properly supported, the work will spring away from the wheel and it will not cut rapidly nor produce a desirable finish.

Grinding machines are economical where it is the practice to make new and repair parts for locomotives to a semi-finished state on automatic machines, turret lathes or center lathes. When fitting parts made to a semi-finished state it will generally be found that the articles can be fitted and finished more quickly by grinding than by turning, filing and using emery paper.

A few examples of grinding from a semi-finished state are given below:

Crosshead Pins.—These are blanked out to from 1/32 in. to ⅛ in. large on the straight and taper surfaces, threaded, keyways cut, etc. When it is desired to fit the pin to the crosshead, the straight portion of the pin is ground with the table set for straight grinding and the tapered portion of the pin is ground with the machine set to the proper taper. When the holes in each side of the crosshead have been reamed at the same time with a single taper reamer, as is generally the case on new work, one end of the pin can be ground about to size and the micrometer dial or stop on the cross feed of the machine set. Afterwards the wheel is shifted to the other end of the crosshead pin and the wheel fed in to the stop. This will insure a proper taper to the pin. In the case the two tapered holes of the crosshead are not of the same taper, owing to unequal reaming, which may be the result of repairs, each end of the pin must be fitted separately. Where the surface to be ground is shorter than the width of the grinding wheel, it is often good practice to feed the wheel directly on to the work without giving it any lateral motion. The latter method can often be followed on the taper ends. Crosshead pins should be carefully finished both for the bearing and the fit in the crosshead. To obtain this finish it is desirable to true the wheel frequently, as will be explained later. The ground surfaces when properly finished are superior to surfaces finished by other methods and the time and cost of doing the work will be found to be less than if the work was done on a lathe.

The grinding machine is very useful when it is necessary to refinish a cut or a worn crosshead pin, as a new surface can be produced by removing a minimum amount of metal.

In fitting worn crosshead pins to other crossheads having holes smaller than the pin, the grinder will be found very useful. In most cases the pin can be fitted and finished quicker on the grinding machine than on the lathe, even though there is a considerable amount of metal to remove. Where conditions will justify, it is advisable to blank out the pins in various sizes, say in steps of ⅛ in., so that they may be fitted to worn crossheads with but a small amount of grinding.

Side Rod Knuckle Pins.—The practice recommended for the grinding of knuckle pins is similar to that for crosshead pins. Some roads make a practice of casehardening these parts. Where this prevails the pins can be made in quantities, with about 1/32 in. being left for finish on the straight and taper fits on new work and possibly ⅛ in. on repair work, the keyways being cut, the holes drilled and the pins casehardened. When it is necessary to fit them to the rods, the straight portions of the pin can be ground to size which will not go below the casehardening, if they are properly pack hardened. The taper ends are then ground to fit the rods. As the casehardened surface on the taper portions is not essential, going below the hardened surface will not affect the wearing qualities of the pin. By follow-

ing this practice a supply of knuckle pins will be on hand ready for fitting to the rods without delay and the pins will be better finished than where the old practice is followed. The warping or distorting of the pins when being case-hardened will as a general rule prevent making a satisfactory fit in the rod or in the knuckle pin bushing unless the pin is ground. Where these pins are not hardened the method of finish would be similar to that for crosshead pins.

Link Motion Pins.—These are small additions to those mentioned above. Where they are casehardened it is, of course, desirable to grind them in order to obtain proper running fits in the bushings. It will often be found that worn pins can be refinished by grinding to fit other arms without annealing.

Air Pump Piston Rods.—New air pump piston rods can be finished economically by blanking them out about 1/64-in. large and grinding. Where rods are worn or scored they can be very quickly ground true with the removal of the least possible amount of metal necessary to true them.

Cank Pins.—Grinding crank pins is ordinary straight work that can be very readily done on a plain cylindrical or gap grinder such as is used for piston rods. When blanking these out on the lathe or turret machine it is advisable to finish the sides of the collars as the present construction of grinding machines is not well adapted to grinding on the sides of the wheel, also it is difficult to properly true the wheels on the sides. It is to be hoped that some of our wheel makers will develop a grinding wheel suitable for grinding on the sides of the wheel for uses similar to that of making crank pins. The lathe work, with the exception of the collars, can be done with the coarsest feed it is possible to take, about 1/32 in. of the diameter being left for grinding. Both the bearings and the wheel fit can be ground economically.

Piston Rods.—A special gap grinder has been developed which is used largely for the grinding of piston rods, the machine having a gap in the bed large enough to swing a piston rod with its head mounted. These machines are used for finishing new piston rods that have been turned previously about 1/32 in. large. Two methods have been used for repairing rods, one being to take a light cut on the lathe and the finishing cut on the grinder, but it has generally been found more economical to do all the repair work required on the rod on the grinder, no matter how badly it may be cut or out of true. With proper wheels and plenty of steady rests, the worst kind of worn rod can generally be refinished in less than 30 minutes and only slightly worn rods in much less time. Some of these gap grinders for piston rods are operated without steady rests; this will not result in obtaining the full output of the machine, however. For rapid grinding and good finish at least three steady rests should be used, these to be gradually adjusted to the rod as the diameter is reduced. Piston rods are from four to six feet long and must be supported to prevent them from springing away from the wheel. Much of the rough appearance of ground piston rods can be attributed to a lack of support for the rods. Probably there is no one part of a locomotive to which grinding is better adapted than the piston rod. With reasonable care the rods can be ground to one size from end to end to within a limit of .001 or .002 in.

Valve Stems.—These can readily be ground on the piston rod gap grinders.

Locomotive Axles.—These being large in diameter and heavy, require large grinders and for a new installation the size known as 20-in. by 96-in. is desirable. The journals and wheel fits may readily be ground on machines of this size. Axles should be roughed to about 1/32 in. above the required finished dimension. The customary gap grinders used for piston rods can be used for axle grinding. As a general rule they are somewhat light for the work; however, where the work on rods is not sufficient to keep the machine busy, axles or crank pins may be ground on these machines to good advantage.

Choice of Grinding Wheels.—In the early days of commercial grinding there was a difference of opinion as to the kind of grinding wheels to use. By some a wheel that would give long life was considered the more desirable. Later practices and knowledge of grinding wheels have shown that while long life is desirable, the latter can be sacrificed for good cutting and finishing qualities; also that a wheel desirable for railway work is one that will wear away at a moderate rate. As previously stated, a grinding wheel may be likened to a circular cutter having a multitude of cutting points. These points will eventually dull and clog from chips gathered from the work. If the wheel is moderately soft the dull points will break away and present new sharp points. A hard, fine wheel, however, will glaze and refuse to cut with the speed desirable for locomotive work. For steel such as is used mostly on locomotives, running about 0.40 per cent carbon, wheels classified by the Norton Company as grade M—36 vitrified, or corresponding grades made by other concerns will generally be found a good compromise and can be used on most locomotive work, especially for general locomotive repairs where one grinder is often used for soft steel and casehardened parts, and where frequent changing of wheels would consume too much time. Where a large number of one article is to be ground at one time, it is, of course, desirable to use different wheels for soft steel, casehardened steel, cast iron, etc., and possibly one wheel for roughing down and a second wheel for finishing.

Truing Wheels.—Brown & Sharpe milling cutters and those of other makers used to be marked, "Keep the cutter sharp." The same should apply to grinding wheels. The only suitable medium for truing and sharpening a wheel is the diamond. It should be used on all plain cylindrical grinders used in railway work. Diamonds can be purchased for $10 to $15 and will last a long time. For jobs such as piston rods, crosshead or crank pins, etc., it is always desirable to grind close to size and true the wheel for the final finishing cut. Truing the wheel takes only a fraction of a minute with the devices for holding the diamond supplied with machines. With a moderately coarse wheel properly trued, a finish can generally be produced that answers all requirements for locomotives.

Cooling Compounds.—Grinding wheels should, of course, be flooded with a cooling compound to prevent heating the work and clogging the wheel. A number of compounds are recommended by the makers of grinding machines. These contain ingredients that prevent rusting of the machine and work. A good grinding compound should always be used; clear water is not satisfactory for this class of work. The nozzle for the cutting compound should be adjusted as close as possible to the point of contact of the wheel and work. No damage will result from too much cooling compound, but bad work will result from too little.

Steady Rests.—Particular attention is called to the value of steady rests. As many as possible should be used in order to prevent the vibration of the work. Even with an article as large as a crank pin one or two rests are desirable.

Feeds.—For roughing down it is generally recommended that the feeds be set to traverse the work in front of the wheel about three-quarters of the width of the wheel for each revolution of the article being ground. It must be remembered that a grinding wheel reduces diameter only at each revolution of the work, a very small amount, rarely over .002 in. This thin layer or chip if spread out to 1½ in. or 2 in. will remove metal fairly rapidly. Grinding can be done much more quickly by a coarse than by a fine feed.

Previous Machining.—Where the practice of grinding is followed, the finish given articles in the lathe or turret

machine can be of the roughest character, thus saving the time taken to provide the smooth surface with a fine feed. A modern grinder will remove the rough surface much cheaper than taking the time to turn it off in the lathe.

Attention to Machine Tool Equipment.—A grinding machine will generally take the place of a lathe in any fair sized railway shop and it costs about the same. Therefore, when additions are necessary the plain grinder should be carefully considered.

Operators for Grinders.—Grinders require good operators who have knowledge of proper measuring and who will take advantage of short cuts and kinks to perform the work quickly and satisfactorily. However, a good lathe hand will generally make a good grinder hand. Given two inexperienced men, one to operate a grinder and one to operate a lathe, the prospects are that the man on the grinder will learn to produce a satisfactory job much sooner.

A TIME-SAVING ATTACHMENT FOR THE PLANER

A handy device used in the Dale Street shops of the Great Northern for planing balance plates of valve chest covers is shown below. A view of the attachment in use is given in Fig. 1, while Fig. 2 shows the dimensions of the parts. The

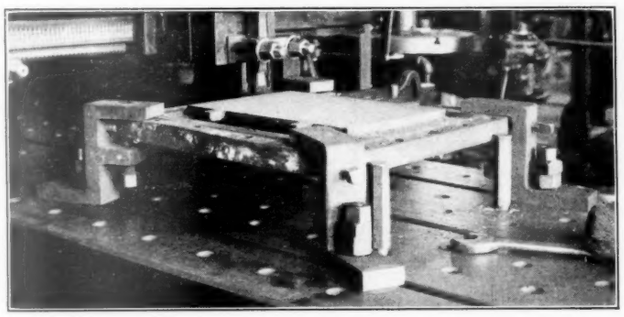


Fig. 1—Method of Planing Valve Chest Covers

four brackets are forged from mild steel and finished to the dimensions given, care being taken to get the surface marked *B* parallel to and the same distance from the base *A* on every bracket. The brackets are attached to the planer as shown and the steam chest cover to be planed is slipped into position

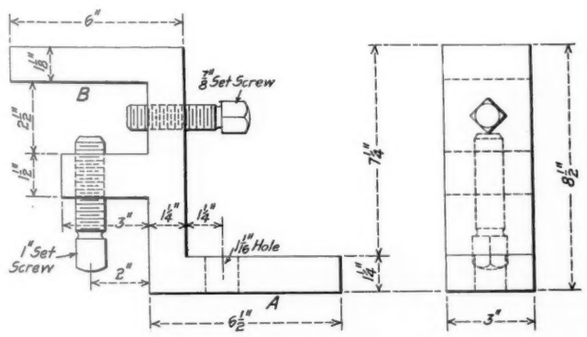


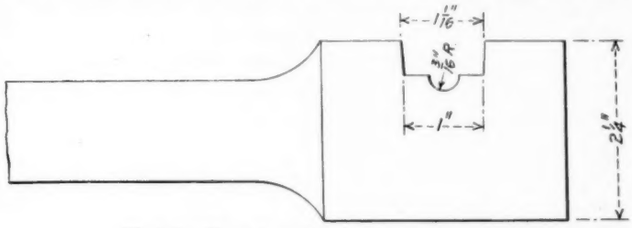
Fig. 2—Details of Brackets for Holding Valve Chest Cover

and the vertical set screws are tightened. This holds the joint surface of the cover against the bracket and brings it parallel with the planer table. The horizontal set screws bearing on the corners keep the cover from moving in the brackets. This attachment makes it unnecessary to use a surface gage when planing balance plates, thus saving considerable time on the operation.

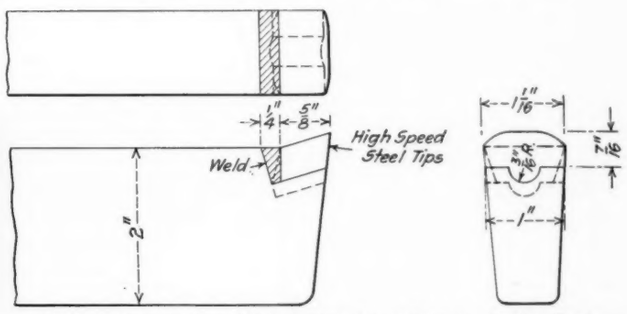
HIGH SPEED STEEL TIPPED TOOLS

BY M. C. WHELAN
Blacksmith Foreman, St. Louis & San Francisco, Kansas City, Mo.

To apply successfully high speed tips on tire steel tool bodies for machine tools has been found quite difficult. The method described below has been used by the writer for some time with success, the tips remaining on the tool body until they are worn away. When the welding of high speed tips on machine tool bodies was first attempted in our shops, it was found difficult to weld a tip on a tire turning tool that

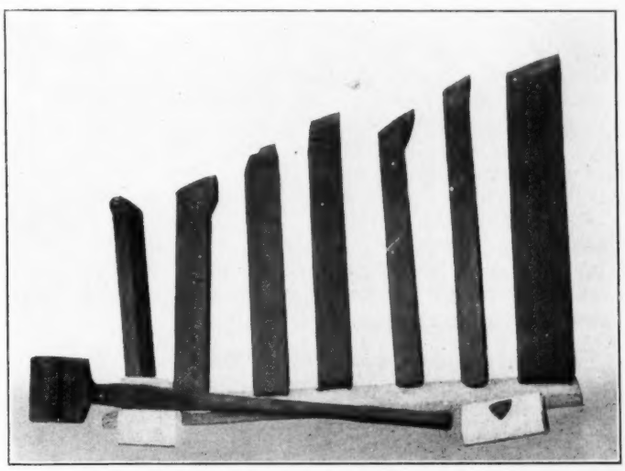


Tool for Forming the High Speed Steel Tips.



Method of Applying High Speed Steel Tips to Lathe Tools

would last for any length of time, no matter how well the weld was made, on account of the vibration and the great side pressure on the tool when heavy cuts and feeds were taken. The weld used was a flat surface weld. After some experimenting the tongue and groove method illustrated in the sketches was tried and it proved successful. This design not only holds the high speed steel tip in place, prevent-



Assortment of Tools Provided With High Speed Steel Tips

ing it being broken off or loosened, but does not require as solid a weld. By taking care not to make the tips too long and by tapping the tips well into the body of the tool, having it seat properly, it is only necessary to weld the back of the tips as shown.

The small steam hammer tool shown in the sketch also is

used for forging the tips from the high speed steel scrap. We use three sizes, viz.: ¾ in., 1 in. and 1½ in. wide for the various sizes of tools.

The photograph shows a number of lathe and planer tools. The picture was taken after they had been in service for some time. The largest one had been used along with one other of the same size in turning 36 pairs of driving wheels. In applying the tips the welding must be done by those who can do it properly.

ELECTRIC WELDING INSTRUCTIONS

BY E. WANAMAKER
Electrical Engineer, Chicago, Rock Island & Pacific

Some of the equipment now on the market assures the practicability of electric welding and the perfectness of the job, provided the person doing the welding has thoroughly learned his trade.

Contrary to the opinions held by many, it is far from a simple process and it will take an operator approximately one year to become a fairly proficient welder on all classes of work, such as would ordinarily be found on a railroad and only at the end of approximately three years will he become expert and then not unless he has studied and worked under the direction of a competent instructor and demonstrator.

The choosing of electric welding equipment should only be entrusted to some person thoroughly familiar with electrical principles, welding and general boiler and machine designs. This done, and the equipment properly installed, the next step is the instruction and breaking in of welding operators. The following are the vital points which it is necessary to master before really successful welding can be accomplished:

1. The operator should be taught all the details of preparing different kinds of work for welding.

2. The proper current strength and size of electrode for the job in hand should be selected. This automatically regulates the speed to that which is most desirable for that particular class of work. Also, special electrodes are necessary for a few certain classes of work and are well worth the extra or additional price necessary to obtain same; however, the special jobs would probably not exceed 2 per cent of all welding done.

3. The study of strains and stresses is the most interesting as well as the most important of all steps connected with the welding art. The preparation of the parts for welding and the proper flowing of the metal are comparatively easy to learn; provided, good equipment and welding electrodes are used. It is, however, self evident that if the problem of strains and stresses is not properly taken care of, failure will occur either in the weld itself or at some weaker point or part of the object welded. It is to be hoped that much attention will be given this point by those interested in electric welding in order that we may benefit by the enormous savings that can be effected by the intelligent use of the electric welding arc.

OPERATING AND MAINTENANCE

Installations of electric welding equipment on the Rock Island are designed and made by the electrical department. The division electricians at the point where welding installations have been made are given sufficient instruction to enable them properly to operate and maintain the equipment, being supplied with references for ordering any repair parts that would eventually be required. As soon as possible after the installation has been completed, the supervisor of electrical equipment, accompanied by an expert demonstrator from the manufacturer visits the point and instructs as many men as deemed necessary in the use of the electric arc. As is evident, these instructions are only preliminary and it is intended to continue giving instruction as frequently as possible in order to realize the full benefit from the equipments.

A complete set of instructions for electric welding has been issued. These begin with an explanation of the electric arc itself, continuing with the proper polarity for different classes of work. The next point covered is the amount of heat used, the kinds and sizes of electrodes and the current and voltage for the different classes of work. Immediately following are the instructions for all kinds of firebox welding, including the proper use of protective shields. This in turn is followed with complete instructions on the proper methods to use in welding frames and cylinders, and in all building-up operations.

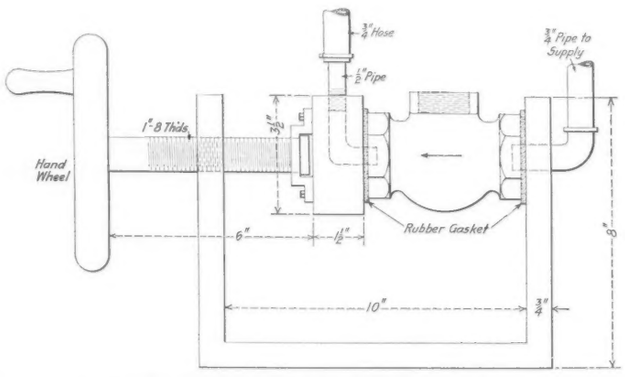
The proper preparation of the work is fully as important as the welding operation, if not even more so. The instruction book supplies detailed sketches showing the proper method of preparing work for welding, including a detail of a small portable sand blast. Several pages are devoted to the properties of iron and steel, in order that welding may be intelligently accomplished. In conclusion, there is a long list of locomotive and car parts, machine tool parts, etc., which it has been found can be successfully and economically welded.

There seems to be practically no limit to the application of electric welding when a good welding machine is intelligently used by a competent operator who thoroughly understands metals as well as the handling of the arc. The results up to the present time indicate that the net returns from the electric welding installation will be far greater than had been anticipated.

METHOD OF TESTING VALVES

BY J. A. JESSON

A simple arrangement for testing air pump and steam heat governors, etc., consisting of a bracket made of ¾-in. by 4-in. bar iron with pipe connection, rubber gaskets and a handwheel for covering the end of the valves is shown in the illustration. The ¾-in. pipe at the right supplies



Device for Giving Valves a Pressure Test

the air for testing, and the hose connection at the left leads to a reservoir in which is placed a test gage. Rubber gaskets are placed on each face of the valve to prevent leakage, the left hand valve head being forced against the valve by the handwheel and screw as indicated by the illustration.

Express Packages by Aeroplane.—The Triangle Distributing Corporation, on October 11, sent a package of films from Buffalo, N. Y., to Rochester, by aeroplane, the shipment having missed the last train by which it could have reached the consignee in season for the afternoon exhibition. The flight, 70 miles in 45 minutes, was made by Roland Rohlfs, of the Curtiss Aviation Training School.

DESIGN OF FORGING MACHINE DIES*

Fundamental Rules Are Given and Explained Which Should Be Followed Where Good Results Are Desired

BY E. R. FROST
General Manager, National Machinery Company, Tiffin, Ohio

IT is our experience that at least 75 per cent of the failures in forging machine die design can be attributed to the disregard of one or more of the fundamental laws pertaining to this work. The desirability of having this information expressed in the form of laws makes the excuse for this paper. Throughout these remarks the policy is followed of not taking into consideration unusual methods; trick heats; welding operations; or, in fact, any laboratory methods which, while possible under certain conditions, are impractical in average shop practice. Consequently, while certain statements may appear to be too limited, they will, in the main, be found as applying to average conditions.

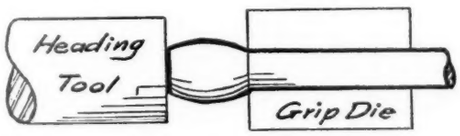


Fig. 1

It is possible to classify the majority of forging machine die problems under three rules or headings.

Rule 1.—*The limit of length of unsupported stock that can be gathered or upset in one blow without injurious buckling, is not more than three times the diameter of the bar.*

As an example, if the diameter of the bar to be upset is 1 inch, then the length of unsupported stock which may be successfully gathered, cannot be more than 3 inches. This rule applies on all diameters of stock. As three diameters, however, is practically the limit, it is best to keep the actual working limit within two and one-half diameters; and where it can be done, even a limit of two diameters is better, as then less attention need be paid to the squareness of the end of the bar. On such upsets, as the heading tool advances, as indicated in Fig. 1, the stock will swell uniformly in all directions from the axis of the blank, and it can be carried to practically any thickness without any serious tendency to upset unevenly. It is immaterial whether the stock overhangs the face of the gripping dies, or whether part of the stock is gathered in the gripping dies and part in the heading tool, whether it is all upset in the gripping dies, or all in the heading tool,—the fact must be kept in mind that such conditions represent cases where the stock is unsupported, and hence Rule 1 applying to three diameters or less of unsupported stock will apply.

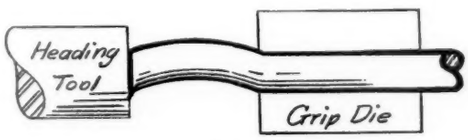


Fig. 2

In order to prove the dependability of Rule 1—if an effort is made to upset a length of stock longer than three diameters, in place of upsetting uniformly, as shown in Fig. 1, the stock will buckle at a point near the middle, and result in more of the upset forming on one side of the center of the bar than on the other. As an example: Assuming that the diameter of the bar is 1 inch, and the length of unsupported stock 4 inches, then when the heading tool advances, the stock will start to buckle, as shown in Fig. 2, and after it has once started, will, of course, continue.

It is impossible to correct this condition by varying the point in the die where the upsetting takes place. The stock will buckle, regardless of whether it is upset in the gripping dies, in the heading tool, or part in the gripping dies and part in the heading tool.

Rule 2.—*Lengths of stock more than three times the diameter of the bar can be successfully upset in one blow, provided the diameter of the upset made is not more than one and one-half times the diameter of the bar.*

This rule, while fairly well recognized, requires a clear understanding in order to develop its practical possibilities.

Referring to Fig. 3; assuming that the diameter of the bar is 1 inch, and the length of stock to be upset is 6 inches,

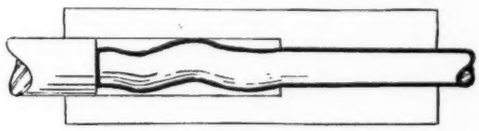


Fig. 3

and that the diameter of the hole in the die is not more than 1½ inches, then when the upsetting begins, the stock will at once buckle, but on account of the limited diameter of the hole the stock soon comes in contact with the sides of the die. This prevents further buckling in this direction, hence any additional upsetting must take place at some other point. The stock will frequently be found to buckle at several points, as in Fig. 3; but as the heading tool advances, the stock will gradually fill the impression in the die, the only objection being a fin around the end of the upset.

If an attempt is made to produce a forging in a die in which the diameter of the hole in the die is greater than one and one-half times the diameter of the bar, then when the upsetting begins the buckling effect at some point—and generally near the middle of the unsupported stock, such as at "I" in Fig. 4—is sufficient so that when the heading tool continues its advance, the stock on the opposite side from the buckled portion will fold in, and, of course, leave a defect in the upset.

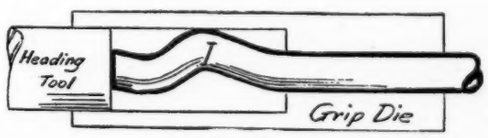


Fig. 4

As in the case of Rule 1, while it is possible to make forgings in which the diameter of the opening in the die is as much as one and one-half times the diameter of the bar, nevertheless, this is very close to the limit, and in practice it is much better to keep the diameter of the upset not more than 1.3 times the diameter of the bar.

The practical application of this law is in the ability to

* Read before the Fourth Annual Convention of the American Drop Forge Association at Cleveland, Ohio.

gather large amounts of stock by repeating the principle, as indicated in Fig. 5. In the first, or top impression, the diameter *K* of the recess in the die is not more than one and one-half times the diameter of the bar *L*. In the second impression, the diameter of the recess *M* is not more than one and one-half times the diameter of the previous upset *N*. In the last impression, the length of the upset *O* is well within the limit of Rule 1 regarding unsupported stock, so that no limit need be put on the diameter *P* of the last die impression. In such upsets, where the length of stock in

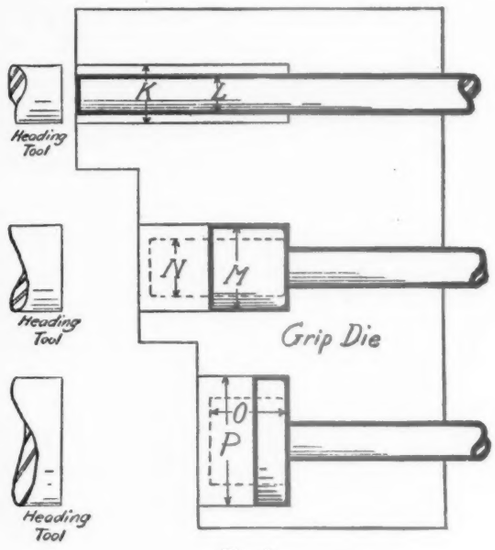


Fig. 5

the first operation is excessive, it is generally necessary to keep the end of the bar at a lower temperature.

Where it is desirable to carefully hold the size of some upset in which the stock requirement is not materially over three diameters in length, if the diameter of the impression in the die is made not more than 1.3 times the diameter of the bar, as in Fig. 6, then the upset formed will be free from fins on the end of the upset, even if no special care is taken in heating. This is on account of the fact that

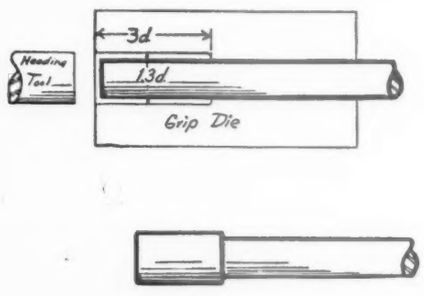


Fig. 6

where the length of the stock is not more than three diameters, the upsetting takes place quite uniformly throughout its length, and any buckling being limited, the friction of the stock along the side of the die does not become a factor.

In handling all upsets requiring more than three diameters of stock, the fact must always be kept in mind that the stock will first start to buckle at the middle of the unsupported portion, and as a result, somewhat more than one-half the stock to be upset must be inside of the impression in the die. It can equally well be in a taper or straight hole in the heading ram; but it is useless to attempt to make part of the impression in the gripping die, and part in the heading tool, because when the up-setting begins, as in Fig. 7, the stock will buckle, leaving a defective forging.

Among the various ways to reduce the number of operations required to make large size upsets on small diameter bars, attention is called to the square hole scheme as shown in Fig. 8. Here an extra amount of stock is obtained in the

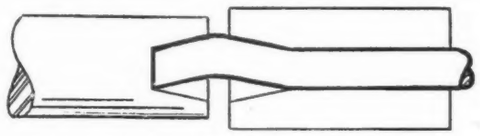


Fig. 7

first upset by making the first impression square, in place of round. The short diameter of the square hole, as at *R*, is made within one and one-half times the diameter of the bar. Consequently, the sides of the square impression in the die support the bar, and keep it from buckling; but the greater area of the square hole enables a larger amount of stock to be gathered than would be possible were the hole round. The next impression is made round, and the diameter of this impression, as at *S* can be one and one-half times the long diameter, or in other words, the diameter across the corners of the previous square upset. The square cor-

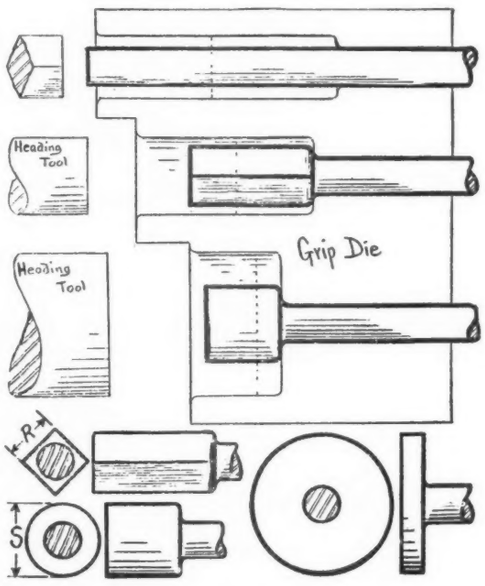


Fig. 8

ners, by coming in contact first with the sides of the die impression, also prevent the bar from buckling and allow a large amount of stock to be gathered. If the length of the stock as it leaves the second operation, has been shortened sufficiently to come within the requirements of Rule 1, then it can be formed in the last operation into any desired shape without regard to the diameter of the die impression.

Another method of increasing the amount of stock that can be gathered in one operation, is to keep the diameter of the impression in the die within the limit of Rule 2 for a distance of slightly more than one-half of the length of the stock, as indicated at *T*, Fig. 9, but then to increase the size of the opening as shown. When the heading tool begins to upset the stock, it will, of course, buckle at *T*, but being supported by the die at this point, and by virtue of the fact that the friction along the side of the die will cause the forward end to upset first, the stock will gradually carry back in the die and produce a uniform upset.

Rule 3.—In an upset requiring more than three diameters of stock in length, and in which the diameter of the upset is one and one-half times the diameter of the bar, the amount of unsupported stock beyond the face of the die must not exceed one diameter of the stock.

This rule, as will be noted, is a combination of Rules 1 and 2. As an example, if the stock to be upset, as in Fig. 10, is 1 inch diameter by 6 inches long, and the diameter of the hole in the die is 1½ inches, then the amount of stock

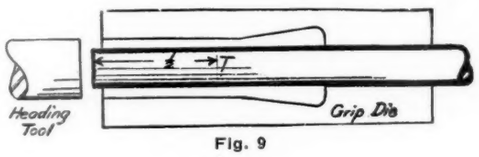


Fig. 9

as at *U*, extending beyond the face of the die must not be more than 1 inch.

However, if the diameter of the hole in the die is reduced below one and one-half diameters, then the length of the unsupported stock beyond the face of the die can be correspondingly increased. If the diameter of the hole in the die is not over one and one-fourth times the diameter of the stock, then the amount of stock beyond the face of the die may be increased to one and one-half times the diameter of the bar.

This rule also applies to cases where the upsetting takes

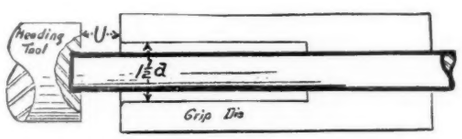


Fig. 10

place in either straight or taper holes in the heading tools. If an effort is made to allow a greater amount of stock unsupported beyond the face of the dies, the stock will buckle outside of the dies.

It will be readily seen that such a limited travel of the heading tool as at *U*, Fig. 10, would not provide sufficient stock to entirely fill the impression in the die, hence in view of the limited heading tool travel on account of Rule 3, many upsets can to advantage be made tapering.

The taper upset possesses many valuable qualifications,

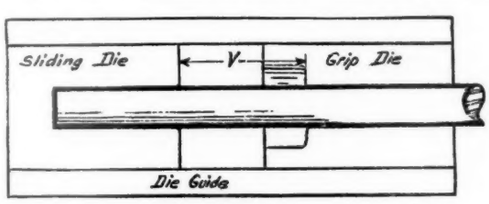


Fig. 11

particularly in that if the angle of the taper is approximately four degrees on each side, the increased diameter of the upset, as the heading tool advances, increases the pressure in the direction of the bottom of the impression in the taper tool, and more fully insures a uniform and well filled upset.

A large amount of stock can be gathered in few operations by this method, for while the first die impression is limited to the size of the bar, thereafter it is the dimensions of the taper upset that governs the size of the next die impression, and not the diameter of the bar.

The taper upset is also valuable in properly distributing the stock at desired points, in more easily filling a large flange, or, by inverting the taper, securing the advantage of filling the outer flange, and enabling the second forming tool to more easily place the stock.

Another form of die having great possibilities, but whose limits are more frequently misunderstood, is the sliding die, as shown in Fig. 11. Such dies are, of course, in quite general use; and are invaluable in upsetting stock at a considerable distance from the end of a bar. Rule 1, however, is still with us, as the total length of unsupported stock, measured from the bottom of the die impressions as at *V*, must not exceed three diameters of the bar.

In case the length of unsupported stock is more than three diameters, as shown in Fig. 12, then both Rules 2 and 3 must be kept in mind as applying to the relative diameter

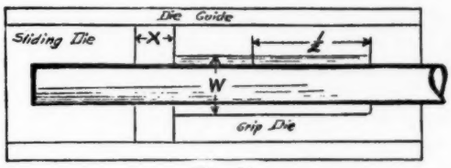


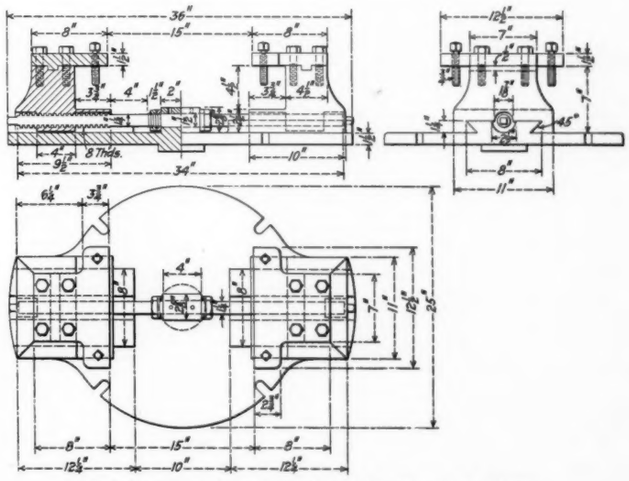
Fig. 12

of the upset, as at *W*, and the length of stock extending beyond the face of the die, as at *X*.

In any extensive application of the sliding die, it is generally necessary to gather stock in several impressions, and here not only must Rules 2 and 3 be kept in mind, but the fact remembered that the friction along the side of the die will cause the upsetting to take place near the front end of the die. For this reason, if the first upset is formed in the near half of the dies, then the second impression should be in the front half; the third impression in the rear half; the fourth impression in the front half, etc., in order in each case to bring that portion of the upset which naturally swells the most, into the bottom of the next impression where it is more difficult to carry it.

UNIVERSAL DRIVING BOX CHUCK

In the shops of the Soo Line a special chuck is used for holding driving boxes while boring the crown brass and facing the hub plate. A drawing showing the construction of the device, which was designed and made in the company's shops, is given below. The base plate has a boss on the lower side to hold it central on the boring mill. The upper



Driving Box Chuck Used in the Soo Line Shops

surface is fitted with dovetailed ways to receive the chuck jaws and has a bearing at the center for the adjusting screw. The upper faces of the jaws are separate parts attached with cap screws to make it easier to set them both at the same distance from the center.

The boxes are placed in the chuck with the hub face up.

As the chuck screw is tightened the box is centered, and after it has been set to give the desired depth of cut in the crown of the brass the vertical set screws on the jaws are tightened. This holds the box securely and it can be bored and faced in one operation.

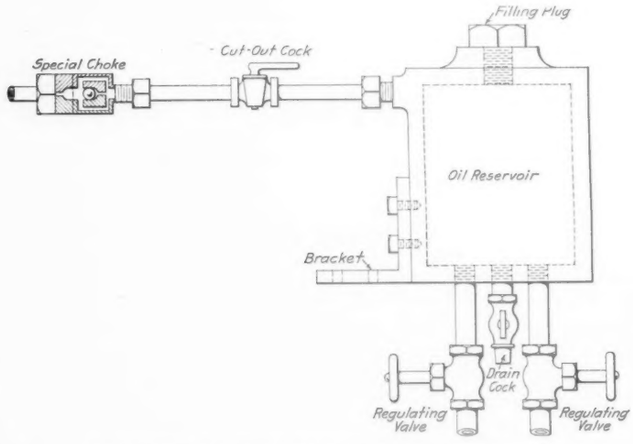
LUBRICATING AIR CYLINDERS OF CROSS-COMPOUND TYPE AIR COMPRESSORS

BY J. H. HAHN
Machinist, Norfolk & Western, Bluefield, W. Va.

Some trouble has been experienced in devising a successful method of lubricating the air cylinders of the cross-compound type of air compressor. A connection from the hydrostatic lubricator is not advisable on account of the condensation that would be carried into the cylinders, thence to the main reservoir and finally to the brake system.

With a view of furnishing a suitable lubricator for lubricating the air cylinders of the cross-compound type of compressor that would eliminate the objectionable features of the hydrostatic lubricator and the hand oilers, the pneumatic lubricator shown in the sketch was designed. All parts of this lubricator can be made in the ordinary railroad shop at little expense. The oil reservoir can be made of a piece of pipe of suitable size (depending upon the number of feeds). Wrought iron or copper pipe can be used.

On compressors equipped with metallic piston rod packing it is necessary to have a four feed lubricator. The special choke fittings are used in the main reservoir pipe,



Lubricator for Cross-Compound Air Compressors

also in the pipes to the high and low pressure air cylinders. No chokes are used in pipes to the piston swabs. The regulating valves are ¼-in. needle valves of the usual design. The cut out cock in the pipe from the main reservoir to the oil reservoir should be closed before the air is drained out of the main reservoir, otherwise some of the oil may escape by the special choke and go into the main reservoir. This cut out cock should also be closed when there is pressure on the main reservoir and if there is any occasion to remove filling plugs, etc.

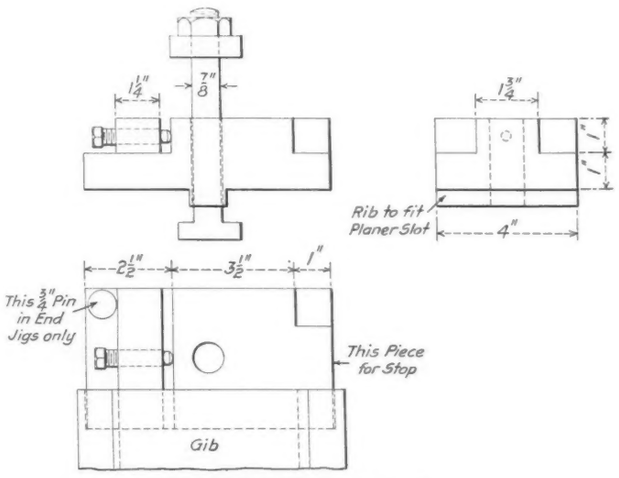
The pipe at the upper left hand corner is connected to the main reservoir and carries air at main reservoir pressure to the oil reservoir. The air pressure insures that the oil pipes and passages remain open. Cold weather has no effect on this lubricator and the amount of condensation that goes into the cylinders is reduced to a small percentage. By regulating the needle valves, the desired amount of oil can be delivered to the cylinders. The special choke fitting was designed to use on the high pressure air cylinder, however, it can be applied to all connections where required.

The lubricator is attached by two of the ¾-in. T-head bolts in the steam head of the pump. No dimensions are given as the installation of the lubricator has to be governed by conditions. In some instances it is desirable to use one lubricator for two pumps and in other cases a separate lubricator for each compressor is required, etc. The special choke fittings are made in two parts and about a ¼-in. ball is used.

JIGS FOR PLANING OUTSIDE OF CROSS-HEAD SHOES

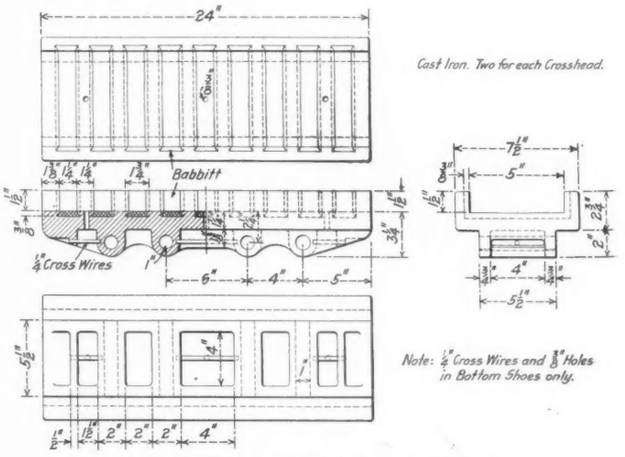
BY LOCKO WALKER
Asst. Machine Foreman, Oregon-Washington Railroad & Navigation Company, Portland, Ore.

Before these jigs were made it used to take us a good six hours to plane four crosshead shoes on the part that fits in the crosshead. Most of this time was consumed in setting up the shoes and trying to keep them from slipping around



Jig for Planing Crosshead Shoes

under the strains of the cut, but with this jig it is possible to finish entire outside of four shoes in less than three hours. The setting up of these jigs is simple. Place the jigs, with the tongue in the slots, in a row, having a bolt long enough



Type of Shoe for Which the Jig Is Used

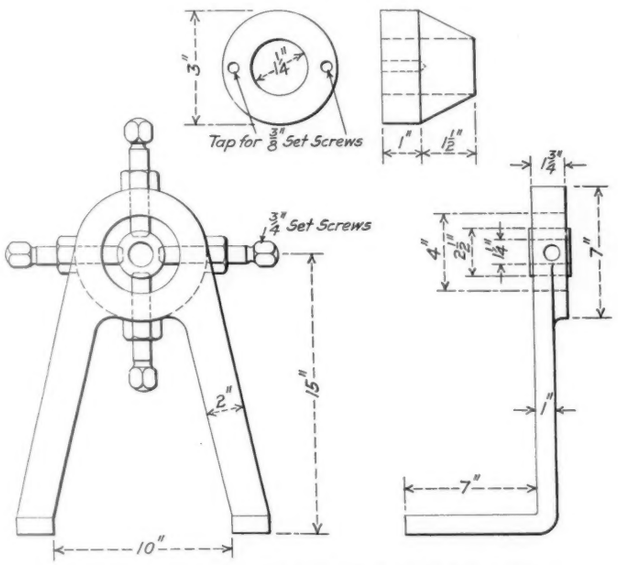
to allow for clamp, run up through jig. Place the shoe on the front jig and pull the second jig up so that the stop on the jig hits the back end of the shoes. Set up the rest of the shoes in the same manner, working from the front.

Then with a socket wrench tighten up the set screw in the loose pieces to prevent side play and then by merely putting the clamps over the bolts and tightening them down with nuts, the shoes are ready for any cut the planer will pull, with both heads cutting.

The jigs are made from scrap found about railroad shops and they will pay for themselves in the planing of eight gibs. Five shoes are required for four shoes.

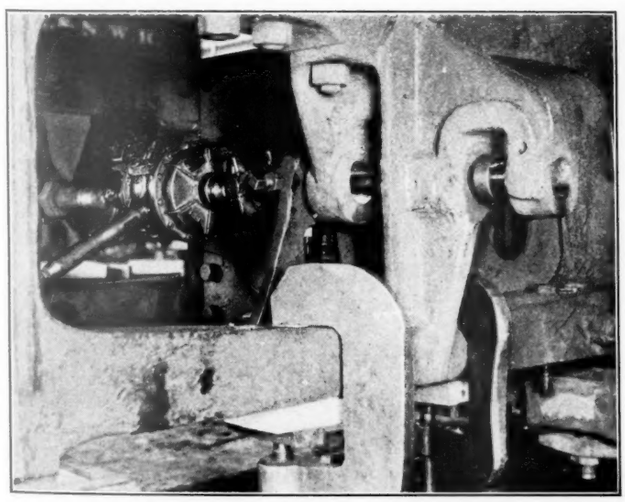
BORING EQUALIZER BRACKETS IN PLACE

It is the practice on most roads to remove equalizer brackets from the frame whenever it becomes necessary to true up the holes and apply bushings. Where the brake hanger pin hole is in line with the equalizer pin the work can be



Bracket for Boring Bar and Self-Centering Bearing

greatly facilitated by an attachment for boring the bracket in place which has been developed at the Boone, Iowa, shops of the Chicago & North Western. The device is shown in



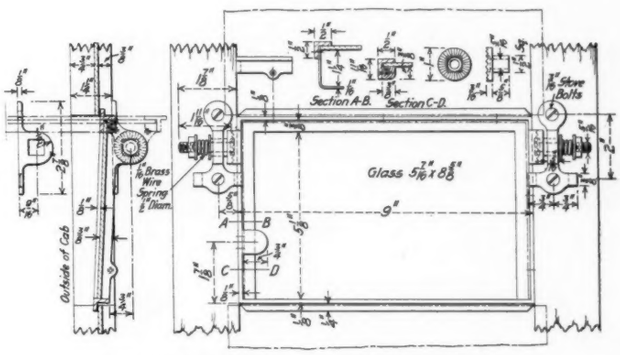
Truing up the Holes in an Equalizer Bracket

use in the illustration below. The cutter bar is driven by an air motor being supported inside the frame by a bracket attached to the lower frame rail by C-clamps. The bearing in this bracket can be adjusted by means of set screws to bring it in line with the center of the hole. The outer end of the cutter bar is held in place by a bearing, one end of which is tapered at an angle of about 60 deg., so that it is self-centering. The tapered bearing is held securely in the brake hanger pin hole by means of set screws. A wooden collar is clamped on the cutter bar so that it maintains a contact with the inner bearing and slides on the bar as the tool is fed forward by the lead screw of the motor, thus preventing the tool from digging into the work.

CLEAR VISION WINDOWS

BY JOHN H. NAGLE
Chief Draftsman, Buffalo, Rochester & Pittsburgh

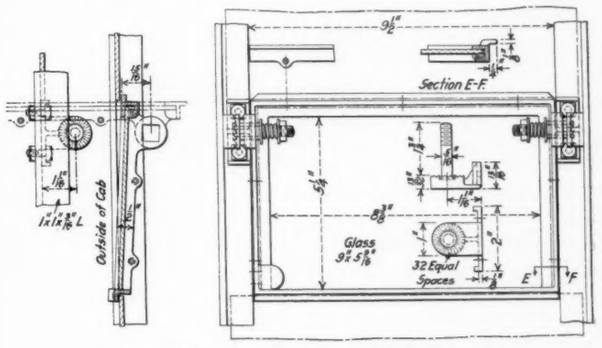
To meet the requirements of the Interstate Commerce Commission, that road locomotives used where snow storms are generally encountered shall be provided with a "clear vision" window at the front and so constructed that they may be easily opened or closed by the enginemen—the Buffalo, Rochester & Pittsburgh has designed a neat and suitable arrangement which is placed in the front doors of all cabs.



Clear Vision Windows for Wooden Cab Doors

The design is suitable for either steel or wood frame doors.

The clear vision glass frame is of light construction, either of cast brass or malleable iron, but preferably of brass, and is held in the open or closed position by means of a clutch and spring, the clutch being made with small teeth. This also keeps the window in any position desired, while the springs may be adjusted to keep the teeth properly engaged.



Clear Vision Windows for Steel Cab Doors

The frame bracket for the steel frame door is provided with a small lip on top which holds the glass in the cab door away from the frame, and the small glass in the frame is held in place by small wood strips and brass screws. Repairs can be made or the glass removed without removing the frame from the cab door.

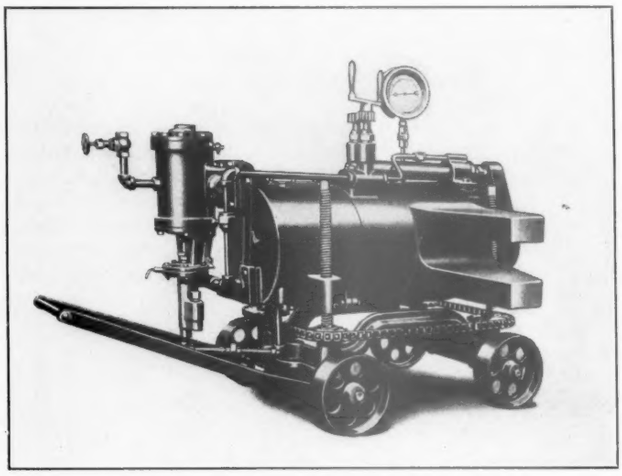
This design has proven entirely satisfactory and has been adopted as standard by this road.

PORTABLE CRANK PIN PRESS

The Watson Stillman Company, New York, has developed a new type of portable press for forcing crank pins into locomotive and engine wheels and for miscellaneous shop and field forcing work. It contains some unusual features in its design and is intended to reduce the time and labor in doing this work.

In this press the hand pump is replaced by one driven by an air engine, the air being taken from the shop air main. The operating valves are so placed that the man in charge can operate the press in addition to directing the work of his men. The use of the air pump eliminates one man, the hand pump operator, from the crew, as well as increases the speed of doing the work approximately three hundred per cent.

The press is equipped with a gage, which accurately indicates pressure required to seat the pin. By this means it



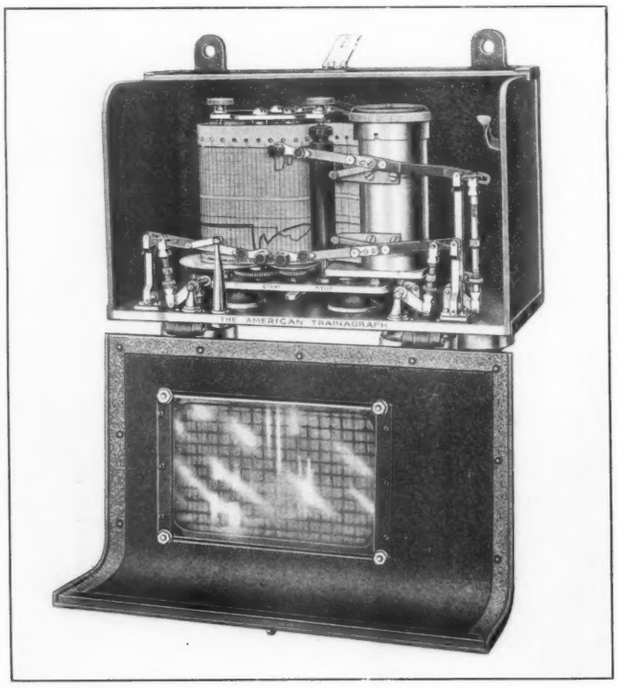
Portable Crank Pin Press of 300 Tons Capacity

is easy to detect a loose fit, which might seriously endanger the performance of a locomotive. The main portion of the press is an open hearth steel cylinder on the sides of which are cast heavy forks which support tie rods. The reservoir is mounted on the rear of the press and the ram operates from the front of the cylinder casting. The whole unit is carried on screws that are mounted on a truck. By turning any one of the screws the center line of the ram can be raised or lowered to meet the center line of the pin. Two tie rods and an abutment beam are used in connection with the press. The distance between the rods is adjustable in the forks so that the rods may be passed through spokes of the wheel at any convenient opening.

The ram is returned by a small hydraulic cylinder mounted on the top of the press, with its piston connected to a lug on the end of the ram. All movements of the ram are controlled by a geared screw stem valve. These presses are built in capacities ranging up to 300 tons.

THE AMERICAN TRAINAGRAPH

An instrument for recording the performance of air brakes has been developed by the American Steam Gage & Valve Manufacturing Company, Boston, Mass. As shown in the illustration it is provided with three pens; the upper one records the pressure in the brake cylinder, the lower one at the left records the brake pipe pressure and the lower one at the right the auxiliary reservoir pressure. The pencil



An Instrument for Giving Continuous Records of Brake Cylinder, Brake Pipe and Auxiliary Reservoir Pressures

motion is such that the pens move in a vertical which provides a record that may very easily be read.

The recording paper is divided horizontally into 5 lb. divisions and vertically in 5 second divisions. The movement of the paper is controlled by a powerful clock which can be started or stopped only when the cover of the recorder is opened as shown in the illustration. It can be locked and sealed in the closed position which makes it impossible for the record to be tampered with.

This instrument is particularly useful for testing air

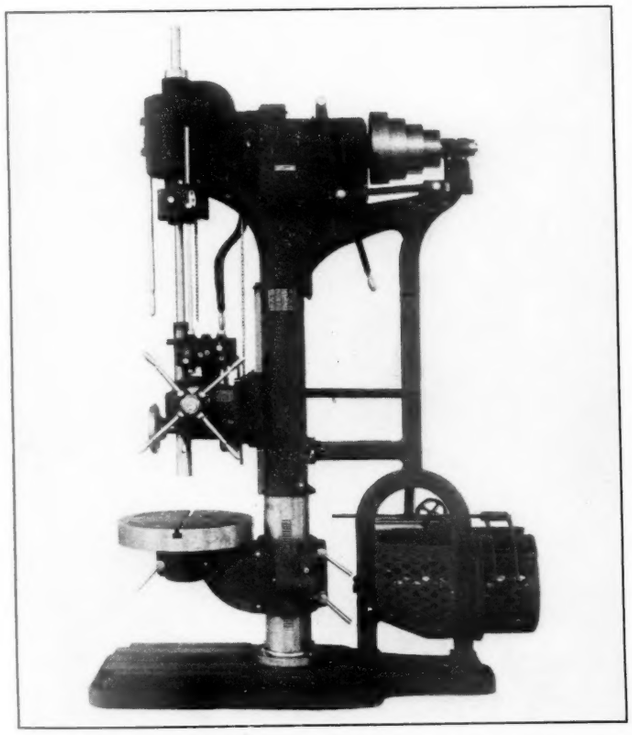
brake equipment and has been designed to meet the particular needs of railway work. It is also of value for checking the performance of the engineman in the handling of a train. It can be placed on the locomotive as well as on cars. A set of 100 of these instruments are being used by the Automatic Straight Air Brake Company in the tests being made on that company's brake, a description of which is given elsewhere in this issue. Samples of charts taken with this instrument are illustrated in connection with that description.

These instruments will give continuous records 24 hours long with one setting which makes them particularly suited for long through service tests.

DRILLING MACHINE WITH TAPPING ATTACHMENT

The illustration shows a friction geared tapping attachment made by the Weigel Machine Tool Company, Peru, Ind., applied to its 25-in. vertical drilling machine. The tapping attachment is mounted directly on the spindle and has a reverse motion of 2 to 1 for the spindle. When tapping is done with the back gears thrown in, which is the usual practice, the spindle has a reverse motion of 12.88 to 1 by throwing the back gear lever onto direct drive.

The lever for operating the tapping attachment is placed in front on the left hand side of the machine close to the back gear lever so the operator can reach either or both



Weigel Drilling Machine with Tapping Attachment

levers without changing his position at the front of the machine. The driving key is made extra long and, having a good bearing on the spindle, prevents any cramping on either of the forward or reverse motion of the spindle. All gearing is entirely enclosed and the splash system of oiling is used. The tapping attachment can be disengaged when no tapping is to be done.

The base of the machine is stiff and well ribbed and has an oil pan extending entirely around the outer edge to keep oil from the floor. The table arm is stiff and is raised and lowered by means of a rack and pinion actuated through a worm and worm gear. The bore for the hub of the table is made large enough to allow a compound table to be substituted at any time. Improved friction type back gears which are easily operated and positive in action are provided. Eight feeds are obtained for each spindle speed ranging from .0040 to .0432 to each revolution of the spindle. Changes are obtained by means of sliding gears operated by convenient levers and indicated by a plate attached to the machine.

An automatic stop which is positive in its action can be set to throw out the feed at any predetermined point. The friction quick return is powerful in action. The four operating levers are placed in the form of a pilot wheel any one of which engages or discharges the feed at will.

The principal dimensions of the machine are as follows:

Extreme height—spindle extended	9 ft. 9½ in.
Traverse of head on column	21 in.
Traverse of spindle	11 in.
Diameter of table	22 in.
Diameter of column	7½ in.
Diameter of spindle above sleeve	1 9/16 in.
Diameter of spindle in sleeve	1 11/16 in.
Diameter of sleeve	2⅝ in.
Spindle bored—Morse taper	No. 4
Ratio bevel gears	2.5 to 1
Speed of tight and loose pulleys	500 r. p. m.
Spindle speeds—open belt	100, 160, 250, 400
Spindle speeds—back gear	15, 25, 39, 62

MOTOR HEADSTOCKS FOR WOODWORKING LATHES

Individual motor drive, now so widely used on machine tools, has been applied to small woodworking lathes by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This company is now manufacturing a line of motor headstocks for either alternating or direct current. Each equipment consists of a motor and controller especially designed for this service.

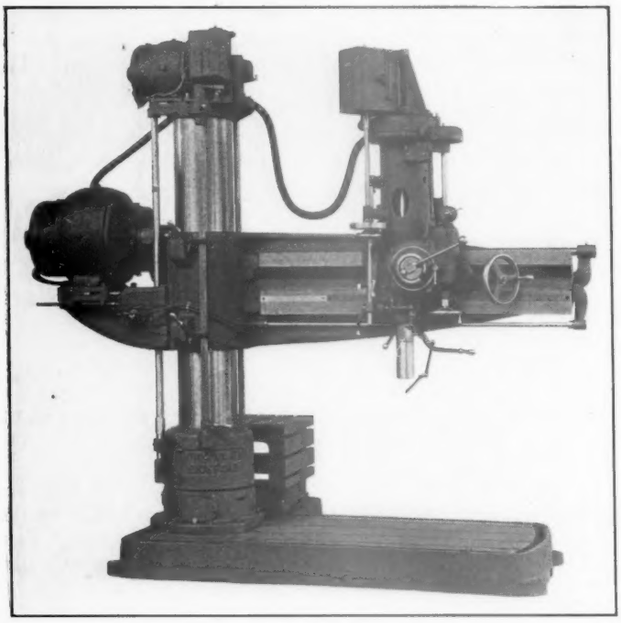
For alternating current circuits a special four-speed ball-bearing motor is furnished. The motor is totally enclosed by solid end brackets which exclude all dust and foreign substances. The feet are cast integral with the brackets to give maximum rigidity. The end thrust in either direction is taken by ball bearings. The end of the motor shaft nearest the tailstock is provided with an internal taper for a live center and a male thread for a face plate. The shaft extension on the opposite end is threaded to take a hand wheel. The controller, mounted in the leg of the lathe, gives motor speeds of approximately 570, 1,140, 1,725 and 3,450 r. p. m. at full load. Dynamic braking for slowing down is obtained by throwing the controller to the next lower speed.

For direct current circuits an adjustable speed, commutating pole, shunt wound motor, is furnished which gives speeds ranging from 600 to 3,000 r. p. m. by control of the field current. It is mounted in the same manner as the alternating current motor and resembles it in general construction. The controller for the direct current equipment is simple in construction. It is mounted in one leg of the lathe and is completely enclosed by a cover plate. Protection against low voltages and overload is afforded by relays which open the line circuit and stop the motor. The operator may stop his machine at any time by opening the main line switch, in which case dynamic braking automatically brings the motor to a quick stop.

The elimination of cone pulleys and belts makes it possible to place this motor in any location desired. It also assures better lighting and affords safety to the operator. It is claimed that the quality of the work is improved by the uniform speeds secured with motor headstocks. The operator can always use the exact speed desired and does not waste any time shifting belts. The construction and design of the equipment are such that occasional inspection and lubrication will keep the apparatus in good condition almost indefinitely and successful operation is assured even with hard usage and unskilled handling.

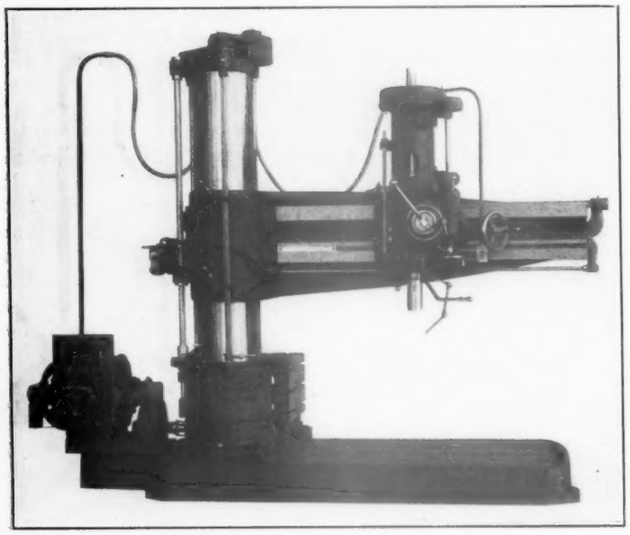
MOTOR DRIVE FOR RADIAL DRILLS

An interesting application of motors to radial drills has been made by the Cincinnati Bickford Tool Company, Oakley, Cincinnati, Ohio, where the variable speed direct connected motors are desired with the machine. The illustrations show two installations. In one case a 3 to 1 variable



Application of Motors to the Arm and at the Top of the Column

speed motor is shown mounted on a bracket attached to the arm of the machine and on the opposite side of the column. The motor is geared directly to the arm shaft. The controller is mounted on the head of the machine. A constant speed reversing compound wound motor mounted on top of the column is used for elevating or lowering the arm. This



Motor Application at the Base of the Machine

motor is controlled by a reversing switch which is operated by a square shaft provided with that company's patented interlocking device.

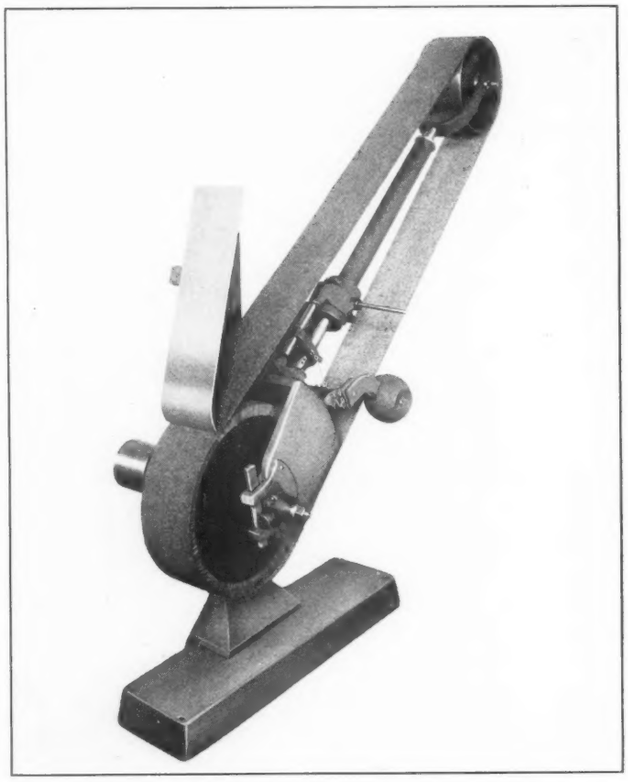
The wires to this motor pass up on the inside of the column, a revolving connection being provided at the base of the column for this purpose. This arrangement may be applied to the company's 4 ft., 5 ft. or 6 ft. radial drills.

The second illustration shows a Reliance adjustable speed motor mounted on the bed of the machine. A small motor for speed adjustment is attached to the larger motor. A remote push button control is used in this case, the push button being located on the head of the machine. As in the previous case this arrangement of motor drive may be applied to the 4 ft., 5 ft. and 6 ft. machines.

ABRASIVE BELT FINISHING MACHINE

The Blevney type B-6 polishing and finishing machine, which is shown in the illustration, has been placed on the market by the Blevney Machine Company, Greenfield, Mass. This machine is designed to do such work as it has been customary to handle on the ordinary set-up or buffing wheel, where the work is held to the wheel by hand.

The patented construction of the wheel and the use of a belt running over this wheel makes it possible to cut better and produce a superior finish to that which may be obtained on the ordinary solid wheel with an increase in production.



Blevney Type B-6 Polishing and Finishing Machine

The cost of abrasive is also reduced and the necessity of carrying a large stock of wheels is overcome.

The wheel is made up of a cast iron hub supporting two steel flanges into which are fitted approximately 225 leather blades attached to metal holding pieces which separate the leather sections from each other and also prevent radial bending of the leather under operating speed. The cloth abrasive belt passes over this wheel on one end of the machine and over a 12 in. idler pulley on the other end, this belt being the finishing member. The abrasive belt is automatically kept in tension by means of a weighted pressure operating through a rack and pinion arrangement directly on the spindle to which the idler pulley is attached. The tension pressure weight when lifted to its extreme position

will lock itself and become inoperative to facilitate the changing of the abrasive belt. A release is provided for this lock. Provision is made for instantly changing the lead of the belt over the cushion.

In operation the abrasive belt runs at the rate of 7,000 ft. per minute, and under this speed the tension of the belt will slightly bend or curve the leather blades. This bending is increased by the pressure of the work being finished causing the belt to be supported at the point of finishing by the corners of the leather blades, while immediately adjoining these supporting points and within the thickness of the blades the abrasive belt is unsupported; in fact, it curves in these places through the action of the pressure of the work, resulting in a receptacle for the chips generated and providing for the free passage of the chips. In other words, there is in effect saw teeth giving high points for cutting and low points for a chip recess, giving a quick and free cutting wheel with unnecessary friction eliminated. As the leather sections bend slightly from their usual position when in constant use, the wheel may be quickly taken off and reversed. In ordinary use, the wheel should be reversed about once weekly.

The wheel bearings are of an approved type lubricated by grease cups. The boxes are contained in the malleable iron section rigidly secured to the main cast iron wheel yoke and it is only necessary to drive out two wedges to remove the wheel and spindle complete. The frame holding the wheel and idler pulley with the other mechanism may be quickly raised or lowered on the column or may be tilted as may be best for the operation in hand.

In the operation of this machine an abrasive belt of suitable grit is used for roughing, a finer belt for the second cut and a dressed down or suitably charged belt for finishing, making three operations where the finish is of a high character. It is claimed that this machine will effect large savings and produce superior work.

AUTOMATIC STARTER FOR INDUCTION MOTORS

The need for an alternating current automatic motor starter has been clearly shown by the constant demand for something which would do for the squirrel cage motor what the automatic starter has done for the direct current motor. The Electric Controller & Manufacturing Company, Cleveland, Ohio, has recently made such a starter. The distinctive feature of it is that all of its parts, including the controlling coils, auto transformer coils and contact coils, are contained in a single case and are all submerged in oil. This device, which is called the E. C. & M. automatic compensator, can be installed by an electrician of ordinary ability and is operated by push buttons. This starter starts a squirrel cage motor in the usual way, in that the motor initially receives a reduced voltage through a transformer and after the attainment of considerable speed the reduced voltage is withdrawn and the line voltage is quickly applied to the motor.

The automatic starter is enclosed in an iron case, fitted at the top with a weather-proof iron cover. Eye bolts hold the cover in place and furnish means by which the starter may be transferred with a crane. A plugged oil hole is provided at the bottom of the case for draining the oil. The necessary leads to the starter emerge at the back, pointing downwards and are sealed hermetically tight where they pass through the case. In compliance with safety requirements the case has convenient means for connecting it to the ground. However, with the cover in place, all the exposed parts are dead, electrically. The compensator can be placed in small quarters with ample safety, or exposed to the severest weather without interference with its operation.

The main contacts are moved by a main control magnet, a relay known as a transition relay and a spring. This is accomplished by an interesting mechanical movement. A brief summary of the sequence of operations of this stater is as follows: First.—The operating magnet is excited, closing the armature, compressing a spring and connecting the motor to the source of supply through the transformer. Second.—After the motor has attained a suitable speed, the transition relay operates a latch, permitting the compression spring to disconnect the motor from the transformer and the transformer from the line, and to connect the motor to the line. Third.—When the operating magnet is de-energized, the armature falls open and the motor is disconnected from the supply lines. Any point on the movable contact completely bounds an enclosed area each time the compensator goes through one cycle of operation, passing progressively from "off" to "start," to "run," and finally again to the "off" position.

The compensator is submerged in oil with the exception of the terminal board used for connecting the transformer voltage taps. The oil accomplishes several purposes; it cools and insulates all parts carrying current, it provides constant and liberal lubrication for the moving parts and it quickly quenches the arc which is formed when the contacts are separated. A special oil is used which has a high flash point, but which is still liquid enough at zero degrees, F., to allow free operation. On account of a large volume of oil and the freedom with which copper particles and carbon can settle harmlessly at the bottom it is not necessary to change the oil for at least five years of average service.

E. C. & M. Automatic Compensator for Alternating Current Motors

The arrangement of taps to the transformer coils is such that by means of the flexible leads it is possible to easily adjust the voltage for starting, that is, if the motor fails to start promptly under normal load conditions with the leads on certain taps, they may be changed to the next higher voltage. When the proper tap has been secured, the cover should be replaced and clamped in place.

The frame and operating mechanism is built in three standard sizes, covering a wide range of motors.

Railway Mechanical Engineer

(Formerly the RAILWAY AGE GAZETTE, MECHANICAL EDITION *with which the* AMERICAN ENGINEER *was incorporated)*

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WE GUARANTEE that of this issue 9,000 copies were printed; that of these 9,000 copies 7,812 were mailed to regular paid subscribers, 113 were provided for counter and news companies' sales, 314 were mailed to advertisers, 218 were mailed to exchanges and correspondents, and 543 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 101,347, an average of 9,213 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

In the Federal Court at Louisville, Ky., the Louisville & Nashville has been fined $200 for violation of the Safety Appliance Act.

In the shops of the Grand Trunk at Stratford, Ont., the female employees have been directed to wear overalls and caps. This is to lessen the danger of accident by catching clothing in machinery.

The Delaware & Hudson is about to reopen its car shops at Green Island, N. Y., near Troy, which have been idle for seven years. The company is now trying to get the 100 men needed to organize a force to repair freight cars at those shops.

The machine shop and roundhouse of the Chicago & Eastern Illinois at Salem, Ill., were destroyed by fire on the morning of October 25. The explosion of a five gallon can of gasolene is believed to have started the fire and the loss is estimated at $200,000.

The New York Central has temporarily suspended the rule under which all employees reaching the age of 70 years are to be retired on pension, and those not physically unfit will be retained in the service. Former employees, now retired on pension, who are physically able and competent to perform some work, will be re-employed temporarily, if they so desire.

The recruiting sergeant at Altoona, Pa., recently received a message from the War Department, reading as follows:

"Five hundred car builders or car repairmen for work in French railway shops, must be recruited in your district at once. They will be rated from $33 to $106 a month." With the message came the information that the men would be assigned to the 35th Engineers of the National Army.

The Alabama Supreme Court holds that the Alabama locomotive headlight law of 1915 has no application to engines engaged in interstate commerce, the federal act of 1911 as amended in March, 1915, having excluded the states from the right to legislate, though the final federal rules on the subject of headlights were not promulgated until after a railroad charged with violating the Alabama law committed the offense.

The Chicago, Milwaukee & St. Paul has announced that the contract for locomotives and substation equipment for its Cascade Mountain electrification from Othello, Wash., to Tacoma and Seattle has been divided between the General Electric Company and the Westinghouse Electric & Manufacturing Company. The section to be electrified is 211 miles long; this, with the 440 miles already electrically operated, will make a total of 651 miles.

Judge Anderson of the United States district court for the district of Indiana, at Indianapolis on October 9 dismissed a complaint of the New York Central against the enforcement of the Interstate Commerce Commission's order requiring the use of high power locomotive headlights. The complaint was dismissed, at the cost of the complainant, on motion of Blackburn Esterline, special assistant to the attorney general, not on the merits of the headlight order but on technicalities regarding the form of the complaint.

The campaign for early shipment of Christmas packages, already started in a number of places, is being pushed jointly by the American Railway Association's car service committees of Chicago, Milwaukee, Wis., and South Bend, Ind. Co-operation is promised by representatives of the National Industrial Traffic League and the Chicago Association of Commerce. Each railroad is to do everything possible to promote early shipments, whether by mail or express. Among prospective recipients are approximately a million soldiers in the various cantonments and training camps. The post-office department has fixed November 15 as the last day for mailing Christmas packages to our soldiers and sailors abroad.

A decision was rendered by the Federal District Court, S. D., Florida, in favor of the government in an action for the penalty for keeping trainmen on duty more than 16 hours. The railroad company claimed that the violation of the 16-hour law was necessary due to the derailment of cars and the impossibility of clearing the track before the time limit was up, the accident occurring at a place where it was impracticable to substitute another crew. The court sustained the government because the railroad was silent as to the cause of the derailment, the court holding that if the derailment could have been avoided by ordinary oversight, the accident could not have been said to be unavoidable, and unless it was unavoidable the railroad had no defense.

Alfred H. Smith, president of the New York Central Lines, has issued a statement showing the immense expenditures of those roads for cars and locomotives during the three years and two months since the war began. The total for locomotives, freight cars and passenger coaches is $84,324,736; and this equipment at the prices prevailing today would

cost $193,028,610, or an increase of 128.91 per cent. Of freight cars the New York Central bought in the three years 38,052 for the sum of $53,762,036, or an average of $1,412.85 per car. The same cars today would cost $133,839,810, an average of $3,519.92 per car. The companies bought 734 engines for $23,768,500, or an average of $32,383.15 per locomotive. The same locomotives would cost today $46,927,000, an average of $63,933.51 each. Passenger coaches bought numbered 445, costing $6,794,200, an average of $15,267.87 per coach. The same cars would now cost $12,261,600, an average of $27,544.16.

Three members of the American Railroad Commission which went to Russia early in the year to study the railway conditions of that country, with a view to extending assistance from this country, have returned to the United States with detailed recommendations in addition to the reports which have been sent by letter and by cable. Those who have returned are W. L. Darling, formerly chief engineer of the Northern Pacific; George Gibbs, consulting electrical engineer; and J. E. Greiner, formerly chief consulting engineer of the Baltimore & Ohio. They have reported a considerable improvement in the congestion at Vladivostok which has hampered the transportation of supplies over the Trans-Siberian Railway. Extensive plans for improving the condition of the road are now under way at Washington and elsewhere, under the direction of S. M. Felton, director-general of railways, for the War Department. Twelve units of railway officers, consisting of division superintendents and their staffs, and including a considerable number of shop men, are being recruited to be sent to Russia. They will be under the direction of G. H. Emerson, general manager of the Great Northern.

Preliminary Locomotive Design

On page 555 of the October issue of the *Railway Mechanical Engineer* a method for calculating the sectional area of locomotive frames was given. An error was made in the number of decimal places for the constants and the table should read as follows:

	O. H. steel	Vanadium
Top of pedestal	T X .00038	T X .00035
Top rail between pedestals	T X .00033	T X .00030
Lower rail between pedestals	T X .00022	T X .00020

Employment of Women in Shops

Railroads in the Middle West are gradually adding more women to their pay rolls to take the places of employees who have left to serve their country. The Northern Pacific recently employed four women for clerical work in the local freight office, eight in the yard office and one in the mechanical department at Duluth, Minn. In addition, the road already had at work six women in the roundhouse in that city, one in a clerical position in the car shops and 14 at manual labor. The women employed for manual labor in the mechanical department are largely engaged in wiping engines and cleaning up around the cinder pits, while of those in the car shops, one works at a bench repairing air apparatus and 13 are in the yard unloading grain-door lumber.

The Chicago, Burlington & Quincy has employed 12 women at its St. Joseph (Mo.) shops to clean up rubbish on repair tracks, sweep shop buildings and wipe locomotives. The Grand Trunk recently employed a woman ticket agent in its Chicago city office, and the Chicago & North Western a station mistress at Ames, Iowa.

Two prominent roads in the East have women at work in track-repair gangs.

Railroad Companies Subscribed for $77,810,000 of the Liberty Loan

The railroads in addition to making strong efforts to secure subscriptions to the second issue of the Liberty Loan among their employees and assisting them in paying for these bonds on a partial payment plan, themselves subscribed for $77,810,000 of the Liberty bonds. They also advertised them extensively to their patrons. The following list gives the amount subscribed by the railroads on record:

Atchison, Topeka & Santa Fe	$7,000,000
Atlanta & West Point	300,000
Chesapeake & Ohio	500,000
Chicago & North Western	3,500,000
Chicago, Burlington & Quincy	5,000,000
Chicago, Milwaukee & St. Paul	2,500,000
Delaware & Hudson	1,000,000
Delaware, Lackawanna & Western	5,000,000
Illinois Central	1,000,000
Kansas City Southern	500,000
Lehigh Valley	1,500,000
Long Island	500,000
Louisville & Nashville	6,000,000
Missouri Pacific	1,000,000
Mobile & Ohio	420,000
Nashville, Chattanooga & St. Louis	250,000
Norfolk & Western	5,000,000
Northern Pacific	10,000,000
Panama	30,000
Pennsylvania	10,000,000
Pittsburgh & West Virginia	250,000
St. Louis-San Francisco	300,000
St. Louis Southwestern	750,000
Southern Pacific	5,000,000
Texas & Orleans	10,000
Union Pacific	10,000,000
Virginian	500,000

Besides the subscriptions of the companies, the Railroads' War Board estimates that the railroad employees of this country have taken more than $50,000,000 worth of the Second Liberty bond issue. For the first bond issue 241,280 railroad employees subscribed an aggregate of $20,027,966.

MEETINGS AND CONVENTIONS

Richmond Railroad Club.—The Richmond Railroad Club has decided to suspend all meetings and activities during the war.

Car Foremen's Association of Chicago.—At the annual meeting of the Car Foremen's Association of Chicago, which was held at the Hotel Morrison, Chicago, on October 8, the following officers were elected: President, H. H. Estrup, general foreman, Chicago & Eastern Illinois; first vice-president, E. G. Chenoweth, mechanical engineer, Rock Island Lines; second vice-president, M. F. Covert, assistant master car builder, Swift & Co.; treasurer, F. C. Schultz, chief interchange inspector, Chicago Car Interchange Bureau; Aaron Kline. The association voted to invest $500 of its funds in five $100 Liberty Bonds of the second series.

Association of Manufacturers of Chilled Car Wheels.—The annual meeting of the Association of Manufacturers of

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Nov. 13, 1917	Draft Gears	Prof. Louis Endsley.	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Nov. 9, 1917	Conservation	J. P. Murphy	Harry D. Vought	95 Liberty St., New York.
Cincinnati	Nov. 13, 1917	Annual Meeting, Election of Officers, Banquet and After Dinner Talk by	Ex-Gov. Jud. Harmon	H. Boutet	101 Carew Bldg., Cincinnati, O.
New England	Nov. 13, 1917	Ordering, Distribution and Use of Supplies	Geo. G. Yeomans	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Nov. 16, 1917	The Woman in Railroad Work	Stuart Brady	Harry D. Vought	95 Liberty St., New York.
Pittsburgh	Nov. 23, 1917	The Problems of the American Republic	Rev. S. McC. Lindsay	J. B. Anderson	207 Penn. Station, Pittsburgh, Pa.
St. Louis	Nov. 9, 1917	(Subject Not Announced)	E. F. Kearney	B. W. Frauenthal	Union Station, St. Louis, Mo.
South'n & S'w'rn.	Nov. 15, 1917			A. J. Merrill	Grand Building, Atlanta, Ga.
Western	Nov. 19, 1917	Fuel Economy		J. W. Taylor	1112 Karpen Building, Chicago.

Chilled Car Wheels was held at the Waldorf-Astoria Hotel, New York, October 9. George W. Lyndon, president of the association, in his opening address called attention to the carrying capacity of the chilled iron wheel, saying in part as follows:

"It is now a well established fact that the load that can be carried on a chilled iron wheel is only measured by the ability of the rail to support it. Many 33-in., 950-lb. chilled iron wheels are running under heavy locomotive tenders of 12,000 gal. capacity, and are giving such a good account of themselves that no other type of wheel is considered by the users.

"We must pay the closest attention to the quality of our product. We must see that the interior of the 625-lb. and 725-lb. wheel receives recognition in the matter of increased plate thicknesses which can only be obtained by additional weight. We must have a reasonable factor of safety when measured by excessive stresses encountered in service, and these heat stresses are now recognized everywhere due to our educational campaign. We are not influenced by commercial consideration in asking for heavier wheels. We know the increased weights are necessary."

The following officers were elected for the ensuing year: George W. Lyndon, president and treasurer; E. F. Carry and J. A. Kilpatrick, vice-presidents; George F. Griffin, secretary, and F. K. Vial, consulting engineer. The following compose the board of directors: J. M. Buick, vice-president, American Car and Foundry Company; J. A. Kilpatrick, president, Albany Car Wheel Company; W. S. Atwood, chief engineer, Canadian Car & Foundry Company; Charles A. Lindstrom, assistant to president, Central Car Wheel Company; F. K. Vial, chief engineer, Griffin Wheel Company, E. F. Carry, president Haskell & Barker Car Company; A. G. Wellington, president, Maryland Car Wheel Works; W. C. Arthurs, president, Mt. Vernon Car Manufacturing Company; J. D. Rhodes, president, National Car Wheel Company; F. B. Cooley, president, New York Car Wheel Company; A. J. Miller, general manager, Ramapo Foundry & Wheel Works, and William F. Cutler, vice-president, Southern Wheel Company.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention postponed.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention postponed.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y. Convention postponed.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio. Convention postponed.

International Railway Fuel Association.—J. G. Crawford, 547 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1126 W. Broadway, Winona, Minn. Convention postponed.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention postponed.

Master Car Builders' Association.—J. W. Taylor, Karpen Bldg., Chicago, Convention postponed.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention postponed.

Niagara Frontier Car Men's Association.—E. N. Frankenberger, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention postponed.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Next meeting, September 10, 1918, Chicago.

Personal Mention

GENERAL

W. J. Bennett, assistant superintendent of motive power of the Denver & Rio Grande, at Denver, Colo., has been appointed superintendent of the motive power and car departments, with the same headquarters, succeeding J. F. Enright, deceased.

T. B. Burgess, assistant division superintendent of the Baltimore & Ohio at Cleveland, Ohio, has been appointed supervisor of locomotive operation of the West Virginia district, with headquarters at Wheeling, W. Va., succeeding T. K. Faherty, transferred.

B. F. Crolley, supervisor of locomotive operation of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, has been relieved of jurisdiction over the Southwest district, and is now supervisor of locomotive operation of the Northwest district, with headquarters at the same place.

Henry C. Eich, whose appointment as superintendent of motive power of the Chicago Great Western, with headquarters at Oelwein, Ia., was announced in the *Railway Mechanical Engineer* for October, was born in Chicago. On January 2, 1883, he entered railway service as an office boy in the general offices of the Illinois Central at Chicago and subsequently became machinist apprentice in the Weldon shops, Chicago. He was then successively machinist in the Weldon shops, locomotive fireman, gang foreman at the Burnside shops, general and roundhouse foreman at Freeport, Ill., division general foreman at Louisville, Ky., and master mechanic at East St. Louis, Ill., Memphis, Tenn., and at the Burnside shops in Chicago. He held the latter position until his appointment as superintendent of motive power of the Chicago Great Western on October 1.

H. C. Eich

A. C. Deverell, superintendent of motive power of the Great Northern, with headquarters at St. Paul, Minn., has been given entire jurisdiction over the mechanical department.

E. B. De Vilbiss, assistant engineer of motive power of the Pennsylvania Lines West at Toledo, Ohio, has been transferred to the general office at Pittsburgh, Pa., succeeding O. C. Wright.

R. D. Hawkins, superintendent of motive power of the Great Northern at St. Paul, Minn., with jurisdiction over part of the mechanical department, has been granted an indefinite leave of absence to enter the Russian Railway Service Corps.

Samuel J. Hungerford, superintendent rolling stock of the Canadian Northern, has been appointed general manager of the Eastern lines, with office at Toronto, Ont., vice L. C. Fritch resigned.

F. Hodapp, road foreman of engines on the Illinois division of the Baltimore & Ohio, at Flora, Ill., has been ap-

pointed supervisor of locomotive operation of the Southwest district, with headquarters at Cincinnati, Ohio.

J. R. JACKSON, assistant engineer of tests on the Atchison, Topeka & Santa Fe at Chicago, has received a commission as captain of ordnance in the Officers' Reserve Corps, but has not yet been assigned to active duty.

CLAUDE M. STARKE, master mechanic of the Illinois Central at McComb, Miss., has been appointed assistant superintendent of motive power of the Missouri, Kansas & Texas, with headquarters at Parsons, Kan. Mr. Starke was born at Water Valley, Miss., on January 15, 1878, and entered the service of the Illinois Central on April 9, 1891, as a clerk at Water Valley. He was subsequently machinist apprentice, machinist and roundhouse foreman, and was promoted to general foreman at Indianapolis, Ind., on April 1, 1909, being transferred to Champaign, Ill., in a similar capacity on September 1, 1911. He was appointed master mechanic at Water Valley on June 1, 1912, and one year later was transferred to McComb. He held the latter position until October 1, 1917, when he received his appointment as assistant superintendent of motive power of the Missouri, Kansas & Texas.

C. M. Starke

WILLIAM KELLY, assistant superintendent of motive power of the Great Northern at Spokane, Wash., has been transferred to St. Paul, Minn.

JOHN M. HENRY, assistant superintendent of the New York division of the Pennsylvania Railroad at Jersey City., N. J., has been appointed assistant general superintendent of motive power of the lines east of Pittsburgh with headquarters at Altoona, Pa. He was born on October 10, 1873, and was educated in the public schools of Altoona and graduated from Purdue University in June, 1900. He entered the service of the Pennsylvania Railroad as a special apprentice in the Altoona machine shops on May 5, 1889. He served as an apprentice until September 1, 1896, when he entered Purdue University, being furloughed from the shops during the school term each year. In June, 1900, he became a special apprentice in the office of the assistant engineer of motive power at Altoona; on July 1, 1901, he was promoted to motive power inspector at Altoona, and in February, 1902, was made assistant engineer of motive power of the Erie division and Northern Central Railway at Williamsport, Pa. He was promoted to master mechanic of the Elmira, N. Y., shops on July 1, 1903, and later served in the same capacity first at the Sunbury shops and then at the Olean shops and at the West Philadelphia shops. On December 1, 1913, he was promoted to superintendent of motive power of the Western Pennsylvania division, at Pittsburgh, Pa., and on May 1, 1916, was appointed assistant superintendent of the Pittsburgh division. He was transferred as assistant superintendent to the New York division on April 15, 1917, and now becomes assistant general superintendent of motive power at Altoona, as above noted.

J. M. Henry

W. M. KELLY, acting general foreman of the erecting shops of the Pennsylvania Railroad at Altoona, Pa., has been promoted to resident inspector in the Philadelphia district. His new duties will consist of following up the performance of trial devices for locomotives.

CHARLES MANLEY has been appointed superintendent of machinery of the Missouri & North Arkansas, with jurisdiction over all mechanical and car departments with office at Harrison, Ark., and the position of superintendent, formerly held by him, has been abolished.

L. S. KINNAIRD, whose appointment as superintendent of motive power of the Chicago & Eastern Illinois, with headquarters at Danville, Ill., was announced in the October *Railway Mechanical Engineer,* was born on July 23, 1869, at Ft. Wayne, Ind., and graduated in mechanical engineering from Purdue University in 1896. He began railway work in 1890 as a draftsman for the Pennsylvania company, serving in that capacity until September, 1892, when he entered Purdue. He worked as a special apprentice in the shops of the Pennsylvania Company during the summers of 1893, 1894 and 1895, and on July 5, 1896, took permanent employment with that company as a special apprentice. On January 1, 1900, he was appointed assistant master mechanic at Allegheny, Pa., and on November 20, 1902, he was appointed master mechanic of the Cleveland, Akron & Columbus at Mt. Vernon, Ohio. Mr. Kinnaird was appointed master mechanic of the Pittsburgh, Cincinnati, Chicago & St. Louis, at Logansport, Ind., on June 1, 1915, which position he resigned on September 30 to become superintendent of motive power of the Chicago & Eastern Illinois.

L. S. Kinnaird

H. A. MACBETH, division master mechanic of the New York, Chicago & St. Louis, at Conneaut, Ohio, has been appointed assistant superintendent of motive power, with headquarters at Cleveland, Ohio.

HENRY YOERG, mechanical engineer of the Great Northern at St. Paul, Minn., has been appointed assistant superintendent of motive power with headquarters at St. Paul, Minn.

A. J. WITCHELL, engineer of tests of the Spokane, Portland & Seattle, has been appointed to the newly created position of assistant to the general superintendent, with office at Portland, Ore.

W. R. WOOD, mechanical valuation engineer of the Great Northern at St. Paul, Minn., has been appointed to suc-

ceed Henry Yoerg as mechanical engineer, with headquarters at the same place.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

R. J. Clark master mechanic of the Great Northern at Spokane, Wash., has been promoted to general master mechanic of the Western district, with the same headquarters, succeeding William Kelly.

T. W. Coe, master mechanic of the Indiana Harbor Belt, at Gibson, Ind., has been appointed master mechanic of the New York, Chicago & St. Louis, at Conneaut, Ohio, succeeding H. A. Macbeth.

C. H. Creager, road foreman of engines of the Baltimore & Ohio, at Cincinnati, Ohio, has been appointed road foreman of engines of the Illinois division, with headquarters at Flora, Ill. succeeding F. Hodapp, promoted.

J. J. Dowling, master mechanic of the Great Northern at Delta, Wash., has been appointed general master mechanic of the central district, with office at Great Falls, Mont., succeeding M. J. Flanigan, promoted.

Charles O. Keagy, general foreman of the West Philadelphia shops of the Pennsylvania Railroad, has been appointed master mechanic of the Middle division of the main line, with office at Altoona, Pa.

C. O. Keagy

Mr. Keagy was born at Woodbury, N. J., on February 15, 1877. He was educated in the public schools and on August 27, 1894, he entered the service of the Pennsylvania Railroad as an apprentice in the Altoona shops. He filled various positions there, until January 1, 1902, when he was appointed an inspector in the motive power department. Mr. Keagy was advanced to assistant chief car inspector on January 1, 1904, and on October 1, 1905, he was made general foreman of passenger car inspectors. He was appointed general car inspector on May 1, 1906, and on April 15, 1907, he was transferred to the West Philadelphia shops as general foreman. He held that position until October 10, 1917, when he was made master mechanic of the middle division, with office at Altoona as mentioned above.

M. J. Flanigan, general master mechanic of the Central district of the Great Northern, at Great Falls, Mont., has been promoted to superintendent at Whitefish, Mont.

J. G. Kircher has been appointed road foreman of engines of the Ohio River division of the Baltimore & Ohio, with headquarters at Parkersburg, W. Va., succeeding E. J. Langhurst, transferred.

Edward Lawless, general foreman locomotive department of the Illinois Central at Freeport, Ill., has been promoted to master mechanic with the same headquarters, succeeding V. U. Powell, transferred.

Charles Lee McIlvaine, master mechanic of the Philadelphia division of the Pennsylvania Railroad at Harrisburg, Pa., has been appointed superintendent of motive power of the Northern division, with headquarters at Buffalo, N. Y. Mr. McIlvaine's photograph and a sketch of his career were published in the *Railway Mechanical Engineer* for June, 1917, p. 363.

M. B. McPartland has been appointed master mechanic of the Denver & Salt Lake, with jurisdiction over the motive power and car departments, with headquarters at Utah Junction, Denver, Colo.

E. W. Smith, assistant engineer of motive power of the Pennsylvania Railroad at Altoona, Pa., has been appointed master mechanic of the Philadelphia division, with office at Harrisburg, Pa., succeeding C. L. McIlvaine. Mr. Smith was born at Charlesburg, W. Va., on September 21, 1885. He is a graduate of the Virginia Polytechnic Institute and he entered the service of the Pennsylvania Railroad on August 1, 1906, as a special apprentice. On July 26, 1909, he was made motive power inspector, was advanced to motive power foreman on September 1, 1912, and on October 15, 1913, he was appointed assistant master mechanic at the Altoona machine shops. On July 1, 1916, he was advanced to assistant engineer of motive power in the office of the general superintendent of motive power at Altoona, and on October 10, 1917, he received his appointment as mechanic of the Philadelphia division.

E. W. Smith

J. M. Mendell has been appointed road foreman of engines of the Cincinnati Terminal division of the Baltimore & Ohio with headquarters at Cincinnati, Ohio, succeeding C. H. Creager, transferred.

O. C. Wright, assistant engineer of motive power of the Pennsylvania Lines West, at Pittsburgh, Pa., has been appointed master mechanic on the Southwest system at Logansport, Ind. Mr. Wright was born on June 20, 1883, at Marion, Ind. He was educated in the public and high school of Marion, and was graduated from Purdue University in the summer of 1905. During his summer vacations he worked in the maintenance of way department of the Pennsylvania Lines West, from June, 1902, until his graduation. He became a special apprentice in the Columbus, Ohio, shops in June, 1905, and in September of the same year was transferred to the Ft. Wayne shops, where he finished his apprenticeship. He was then made assistant night enginehouse foreman at Ft. Wayne, following which he was an electrical engineer, then assistant engineer of motive power at Ft. Wayne. On January 1, 1917, he was made assistant engineer of motive power in the office of the

O. C. Wright

general superintendent of motive power, at Pittsburgh, and on October 1, 1917, he was promoted to master mechanic at the Logansport, Ind., shops.

H. P. MEREDITH, master mechanic of the Maryland and Delaware divisions of the Philadelphia, Baltimore & Washington, at Wilmington, Del., has resigned to go into other business.

T. M. PRICE, assistant master mechanic of the Seaboard Air Line at Andrews, S. C., has been appointed master mechanic at Hamlet, N. C., succeeding T. L. Reed.

E. C. RODDIE, district foreman of the Illinois Central at New Orleans, La., has been promoted to the position of master mechanic at McComb, Miss., to succeed C. M. Starke resigned.

O. B. SCHOENKY, superintendent of shops of the Southern Pacific at Los Angeles, Cal., has been appointed master mechanic of the Tucson division, with office at Tucson, Ariz., succeeding W. C. Peterson, transferred.

F. W. SCHULTZ has been appointed master mechanic of the Kansas City, Mexico & Orient of Texas at San Angelo, Texas, succeeding T. C. Kyle.

M. K. WALSH has been appointed road foreman of engines of the Wheeling division of the Baltimore & Ohio, with headquarters at Benwood Junction, W. Va., succeeding W. F. Ross, deceased.

SHOP AND ENGINEHOUSE

WILLIAM F. BLACK, acting erecting shop foreman of the New York Central at Avis, Pa., has been permanently appointed to this position. He was born in 1883 and was educated in the common and high schools of Oswego, N. Y. His first experience in railroad work was in 1901 as an apprentice at the Oswego shops of the New York Central. In 1909 he was appointed apprentice instructor and assistant machine foreman there and in 1911 was promoted to the position of apprentice class instructor. In March, 1914, he was transferred to Avis, Pa., as chief draftsman and apprentice instructor and received his appointment as erecting shop foreman on September 21, 1917.

E. H. NEWBURY, assistant master mechanic of the Monongahela division of the Pennsylvania Railroad at South Pittsburgh, Pa., has been appointed shop inspector in the office of the superintendent of motive power at Pittsburgh, Pa.

H. R. VOELKER, foreman in the shops of the Pennsylvania Lines West at Bradford, Ohio, has been promoted to general foreman in the shops at Louisville, Ky.

SAMUEL VOGEL, enginehouse foreman of the Pittsburgh, Cincinnati, Chicago & St. Louis, has been pensioned after 42 years of service for the Pittsburgh division. Mr. Vogel was born on July 13, 1852, at Tuscarawas, Ohio, and entered the service of the Pan Handle on March 2, 1875, as a laborer in the shops at Dennison, Ohio, later serving as apprentice, machinist and gang foreman. He was promoted to enginehouse foreman at Dennison on September 1, 1890, and was transferred to Pittsburgh on December 1, 1891, as enginehouse foreman, later to Sheridan, Pa., and then to the Scully enginehouse, where he was in charge at the time of his retirement.

PURCHASING AND STOREKEEPING

H. A. ANDERSON, special agent in the purchasing department of the Pennsylvania Railroad at Philadelphia, Pa., has been promoted to assistant purchasing agent with headquarters at Philadelphia. He entered the service of the Pennsylvania Railroad in July, 1883, as a messenger in the transportation department at Altoona, Pa. Three years later he was transferred to the motive power department where he served as clerk in the Juniata shops, and later as chief clerk to the general superintendent of motive power. In February, 1904, he was promoted to stock clerk in the purchasing department, and in December of the following year was made special agent of the purchasing department, which position he held at the time of his recent appointment as assistant purchasing agent.

JOHN E. BYRON, whose appointment as general storekeeper of the Boston & Maine with headquarters at Boston, Mass., has already been announced in these columns, was born on December 4, 1874, at Concord, N. H., and received his education in grammar, high school and business college. He began railway work on April 25, 1892, as clerk and stenographer to the general manager of the Concord & Montreal, and on July 22, 1895, became superintendent's clerk on the Southern division of its successor, the Boston & Maine. In November, 1911, he was appointed chief clerk in the maintenance of way department and in August, 1917, was appointed general storekeeper of the same road, as above noted.

A. L. COCHRANE, general storekeeper of the Denver & Salt Lake at Denver, Colo., has been appointed purchasing agent and storekeeper succeeding C. N. Davids, resigned.

J. F. ESCH has been appointed purchasing agent of the Colorado Midland, with headquarters at Colorado Springs, Colo., in place of C. N. Davids, resigned.

D. T. JONES, stationer of the Pennsylvania Railroad at Philadelphia, Pa., has been promoted to assistant to purchasing agent.

B. P. PHILLIPPE, coal agent in the purchasing department of the Pennsylvania Railroad at Philadelphia, Pa., has been promoted to assistant to purchasing agent.

ROBERT E. SCOTT, assistant roadmaster of the Oregon Electric, has been appointed purchasing agent of the Spokane, Portland & Seattle, with headquarters at Portland, Ore.

NEW SHOPS

CHICAGO GREAT WESTERN.—A contract has been awarded by this road to T. S. Leake & Co., Chicago, for the construction of an 11-stall roundhouse at Clarion, Iowa. The structure will replace a 14-stall building, which was destroyed by fire last April.

PHILADELPHIA & READING.—This company is building a 15-stall, one-story enginehouse at Reading, Pa., on a site located north of the shops on Sixth street. It will be 110 ft. wide and 418 ft. long. The entire structure is to be of reinforced concrete and brick; Henry E. Baton, Philadelphia, Pa., is the contractor.

BUFFALO, ROCHESTER & PITTSBURGH.—Work is now under way near Punxsutawney, Pa., on the construction of a new engine terminal, a 16-stall roundhouse and auxiliary facilities. The work includes changing the course of a highway from the east to the west side of the tracks for a distance of over one mile and ten miles of additional yard track will be constructed. It is expected that the work will be finished by January next.

ILLINOIS CENTRAL.—This company has awarded a contract to G. A. Johnson & Son, Chicago, for the following improvements at Memphis, Tenn.: The construction of new racks and bins in the storehouse, remodeling the mill building, erection of platforms and incline at the mill building, plumbing and sewerage work, construction of transfer table pit and engine hoist pit, and erection of coach yard building. The estimated cost of the work is $50,000. A contract for additional work at Clinton, Ill., has been awarded to T. S. Leake & Co., Chicago. Eleven stalls in the roundhouse will be lengthened at a cost of about $60,000.

Supply Trade Notes

The Falls Hollow Staybolt Company has removed its Chicago office from the Fisher building to 654 Railway Exchange building.

C. W. Cross has been appointed district manager of the Oxweld Railroad Service Company with office at 233 Railway Exchange, Chicago.

The International Oxygen Company, 115 Broadway, New York, announces the resignation of P. J. Kroll as the company's representative for Pittsburgh and middle western territory.

H. F. Bardwell has been appointed New York district manager for the Vanadium-Alloys Steel Company, Pittsburgh and Latrobe, Pa., with offices at 30 Church street, New York.

Fayette H. Reed has been appointed special agent of the Acar Manufacturing Company, New York, covering the states of California, Nevada, Oregon, Washington, Arizona, New Mexico and Utah, with office at San Francisco, Cal.

Emil Tyden, inventor of the Tyden car seal, and vice-president of the International Seal & Lock Company, Chicago, has been commissioned a major in the army and assigned to the ordnance section, located at Washington, D. C.

Edmund Barany, machine designer of the Singer Manufacturing Company, Elizabeth, N. J., has assumed the duties of mechanical engineer and assistant to general superintendent of the Cleveland Twist Drill Company, of Cleveland, Ohio.

The Continental Construction Corporation has been chartered in Delaware with a capital of $100,000 to manufacture railway supplies. The incorporators are: C. L. Rimlinger, M. M. Clancy, Wilmington, Del., and Clement M. Egner, Elkton, Md.

Berry Brothers, varnish manufacturers, Detroit, Mich., have prepared an illustrated folder containing instructions on how to recognize military insignia, together with a full page half-tone display of the various marks of rank and distinction in the army and navy.

The Ward Leonard Electric Company, Mt. Vernon, N. Y., manufacturers of electric-controlling devices and vitreous enamel insulation resistance units, announces that it is now represented in Cleveland, Ohio, by the Walter P. Ambos Company, with offices in the Arcade.

Morrill Dunn, vice-president of McCord & Co., and Fred A. Preston, manager of sales of the P. & M. Company, Chicago, have been commissioned captains in the Signal corps of the U. S. army and have been assigned to duty with the Air Craft Production Board in France.

The Walter A. Zelnicker Supply Company, St. Louis, Mo., has recently secured the services of W. H. Bramman, who is acting in the capacity of assistant to the president. Mr. Bramman before becoming associated with the Zelnicker Supply Company was connected with the American Carbon & Battery Company.

The Pacific Car & Foundry Company, Seattle, Wash., was recently incorporated to build standard railway equipment, logging cars, trucks, contractors' equipment, forgings, castings, iron and steel and railway supplies in general. The new company has taken over the business of the Seattle Car & Foundry Company and now operates fully equipped car plants both at Seattle, Wash., and Portland, Ore. The officers are: William Pigott, president; O. D. Colvin, vice-president and general manager; James F. Twohy, vice-president and treasurer; James E. McInery, secretary, and T. G. Haywood, director of purchases.

The Keith Railway Equipment Company, 122 South Michigan avenue, Chicago, recently bought 33 acres near Hammond, Ind., and has begun the construction of a shop, 200 ft. by 85 ft., for the construction and repair of tank cars. Later two other buildings will be added, one of which will be 350 ft. by 300 ft. and the other 200 ft. by 70 ft.

Warren R. Roberts, president of the Roberts & Schaefer Company, engineers and contractors, Chicago, has received a commission as major under the Quartermaster General as executive officer in charge of new emergency construction work during the war. Mr. Roberts left Chicago on October 22 to take up his active work and residence in Washington.

The Baldwin Locomotive Works, in the week ending October 20 turned out 72 locomotives. This is at the rate of more than 3,600 a year, compared with 1,989 for the year 1916 and 2,666 in 1906, which was the previous record year. The company is employing an army of 20,000 men and work on government orders engages every department.

John J. Harty, vice-president and general manager of the Canadian Locomotive Company, Kingston, Ont., has been elected president of the company. He is also a director of the Dominion Foundries & Steel Company and is a son of William Harty, who was, some years ago, president of the Canadian Locomotive Company and is still one of its largest stockholders.

On October 1, 1917, the New York sales offices of the Edison Storage Battery Company, long located at 206 West Seventy-sixth street, moved into larger quarters, at 209 West Seventy-sixth street, just opposite the old headquarters. At the new location many additional facilities have been installed to enable the manager, John Kelly, to take care of the increased business.

Frank B. Archibald, for the past five years eastern manager of the National Lock Washer Company, has been elected vice-president; J. Howard Horn, eastern representative for the past seven years, has been appointed sales manager. On or about December 1, offices will be opened in Philadelphia, Pa., and St. Louis, Mo., in addition to present offices in Chicago and Detroit, Mich.

The Westinghouse Electric & Manufacturing Company announces another increase in wages for shop employees aggregating nearly $2,000,000 a year. Effective October 16, all employees observing shop hours, except munition workers, will receive an additional bonus of 10 per cent if they are on a salary or time-rate basis, and of 7 per cent if they are on a piece, premium or task basis.

William S. Bostwick and Chester A. Lyon, formerly with the Magnus Company, Inc., Chicago, announce the formation of the Bostwick-Lyon Bronze Company, of Waynesboro, Pa., and that they have taken over the entire plant of the Waynesboro Foundry & Machine Company, and have fully equipped it as a modern foundry for the manufacture of brass castings, journal bearings and babbitt metal.

The Blevney Machine Company, Greenfield, Mass., has recently been organized as a Massachusetts corporation and has purchased the entire business, plant, etc., of John C. Blevney, of Newark, N. J., manufacturer of a patented line of grinding and polishing machinery, also friction clutches. The company is now making ready a new modern factory at Greenfield and expects to have this new plant in operation within sixty days. W. S. Howe has resigned as treasurer and general manager of the Nutter & Barnes Company, and as general manager of the machinery division of the

Greenfield Tap & Die Corporation, to become president and treasurer of the Blevney Machine Company and will be the active head of this new concern. The Blevney patented two-belt grinding and finishing machines are an innovation in the metal finishing field.

J. J. Byrne has been appointed eastern representative of the Locomotive Stoker Company of Pittsburgh, Pa., with office at 50 Church street, New York City. Mr. Byrne entered railroad service in 1903, on the Cleveland, Cincinnati, Chicago & St. Louis as machinist apprentice. He served four years in this capacity at the Delaware shops. He entered the service of the Lake Shore & Michigan Southern as machinist in 1907, and remained with that company until 1909, at which time he entered the employ of the Locomotive Stoker Company as mechanical expert. Mr. Byrne will devote much of his time to the Southern roads.

Oscar F. Ostby, has opened offices at 2736 Grand Central Terminal, New York, to handle general railway supplies. He has been appointed eastern representative of the Grip Nut Company, Chicago, and manager of sales of the Glazier Manufacturing Company of Rochester, N. Y., the latter company making a complete line of oil headlights and reflectors and cases for all kinds of headlights. Mr. Ostby has been one of the energetic members of the Railway Supply Manufacturers' Association, having been its president in 1915-16. He has been much interested in the locomotive headlight field in the interest of the International Acetylene Association. Mr. Ostby was born March 5, 1883, and received his education in the public schools of Providence, R. I. From 1901 to November, 1904, he was engaged in publicity work. Since then he has been connected with the Commercial Acetylene Railway Light & Signal Company and the Refrigerator, Heater & Ventilator Car Company, serving the latter company as general manager.

O. F. Ostby

Major P. G. Jenks, Quartermaster Officers' Reserve Corps and in civil life assistant to the president of the Standard Steel Car Company, Chicago, presented regimental and national colors to the Thirty-fifth Engineers at Rockford, Ill., on October 19, on behalf of car construction companies which have orders from the government. Very appropriately the presentation speech was made by Louis Pitcher, a civil war veteran, who exactly 53 years before (October 19, 1864.) was color bearer in the Union army in the battle of Cedar Creek. The Thirty-fifth Engineers is a railway regiment which is being recruited for the purpose of doing car construction work on the American-operated lines in France.

H. P. Meredith, master mechanic of the Maryland and Delaware divisions of the Philadelphia, Baltimore & Washington, has resigned to go to E. I. du Pont de Nemours & Co. as engineer in charge of mechanical maintenance and shop methods, with headquarters at Wilmington, Del. He was born January 12, 1879, in Gloucester county, Virginia, and was educated in private schools in Virginia and public schools of Altoona, Pa. He entered the service of the Pennsylvania Railroad as a special apprentice in 1897. In 1901, he became motive power inspector of the Buffalo & Allegheny Valley division at Buffalo; in 1903, he was promoted to assistant master mechanic of Altoona machine shops, and on July 1, 1905, was promoted to the position of assistant to the general superintendent of motive power at Altoona. He was made master mechanic of the Baltimore division at Baltimore, Md., on May 1, 1910, and on October 15, 1914, was promoted to master mechanic of the Williamsport and Sunbury divisions, with headquarters at Sunbury, Pa. On July 1, 1916, he was promoted to the position which he has just resigned. He is a member of the American Socety of Mechanical Engineers, the Master Car Builders' Association, and the American Railway Master Mechanics' Association.

Clement F. Street has opened an office as consulting mechanical engineer at 50 Church street, New York. He will give special attention to questions of design and tests of railway equipment and specialties. Mr. Street at the age of 18 became a machinist apprentice at the works of the Buckeye Engine Company, and after three years entered the drawing room of that company. Later he became chief draftsman of the Johnstown Company, Johnstown, Pa., leaving after two years to become chief draftsman in the motive power department of the Chicago & St. Paul Railway, where he remained for four years. In 1892 he became mechanical editor of the Railway and Engineering Review of Chicago. Seven years later he went with the Dayton Malleable Iron Company and for nine years was engaged in designing and selling railway supplies for this company, for the Wellman-Seaver-Morgan Company, Cleveland, Ohio, and for the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. In 1907 he started to develop a locomotive stoker with the financial assistance of the Westinghouse Air Brake Company, this work finally developing into the formation of the present Locomotive Stoker Company, of which Mr. Street is vice-president and director. In 1916 the John Scott Legacy Medal and Premium was awarded to Mr. Street on the recommendation of the Franklin Institute of Philadelphia for his work in developing the Street stoker.

Joseph T. Ryerson & Son

Joseph T. Ryerson & Son, Chicago, celebrated the seventy-fifth anniversary of its organization on November 1. The founder, Joseph T. Ryerson, came to Chicago in 1842 and located in a two-story brick building near Clark and Water streets. He secured a stock of $20,000 worth of iron and began business as the accredited agent of Wood, Edwards & McKnight, of Pittsburgh. In 1879 he took his son, Edward L. Ryerson, into partnership, and upon his death on March 9, 1885, the business passed to his son. Edward L. Ryerson continued as president of the company until 1911, when he was made chairman of the board of directors. His sons, Joseph T. Ryerson, Donald M. Ryerson and Edward L. Ryerson, Jr., have entered the firm during the past 15 years and are now vice-presidents.

The Chicago plant of the firm has grown continuously in size with frequent changes in location to permit further expansion and at the present time is located at Sixteenth and Rockwell streets.

The eastern plant of the company occupies a 10-acre site on West Side avenue, Jersey City, at the junction of the Hackensack river and Newark bay. The building is 245 ft. by 470 ft., with a floor space of approximately 137,000 sq. ft. The company acquired a St. Louis plant by purchasing the W. G. Hagar Iron Company, thereby adding to its own products a line of mill, mine and boilermakers' supplies manufactured by the Hagar Company. A new plant was opened at Detroit, Mich., on November 1, to take care of the increased demand for quick shipments of iron and steel in the territory served by that city.

CATALOGUES

THOR DRILLS.—The Independent Pneumatic Tool Company, Chicago, has issued a folder illustrating the various types of piston air drills, pneumatic hammers and electric drills manufactured by that company. A table is also included giving the detailed characteristics and suitable service for each type of equipment.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., has recently issued Record No. 87 on the subject of military supplies. In this pamphlet is included a description of what the Baldwin Locomotive Works has done for the war, mentioning the Consolidation type locomotive built for the United States government and giving a record of the time in which this locomotive was built.

STAYBOLT IRON.—The Rome Iron Mills, Inc., 30 Church street, New York, has issued Bulletin No. 1 on Rome hollow staybolt iron. These staybolts are made with the telltale holes in them and the advantages obtained by using this material are explained. Illustrations showing the texture of the material from the nick and bend test and places in the firebox where these staybolts are particularly advantageous are shown.

POWER REVERSE GEAR.—The Economy Devices Corporation, 30 Church street, New York, has issued bulletin No. 115 describing the type "B" Ragonnet power reverse gear, which is a new design recently placed on the market. The catalogue enumerates the advantages of the power reverse gear and explains the cushioning principle of the type "B" gear. A sectional drawing of the gear is included showing the names of the various parts of the gear.

LOCOMOTIVE FEEDWATER HEATING.—The Locomotive Feedwater Heater Company, 30 Church street, New York, has issued its first bulletin describing the advantages to be obtained by heating the feedwater for locomotive boilers. The bulletin points out the saving to be made in waste heat feedwater heating. Charts showing what economy may be expected by heating the feedwater with exhaust steam from the cylinders are given, and illustrations are included showing the application of the feedwater heating apparatus to locomotives.

HEAT INSULATION.—The Magnesia Association of America, 702 Bulletin building, Philadelphia, Pa., has issued a leaflet of 40 pages called "85 per cent Magnesia and Heat Insulation." The purpose of the book is to present the latest and best information on heat insulation. Particular stress is laid on "85 per cent Magnesia" and its development is described. The various types of insulation made with this product and the uses to which this material may be put are mentioned. Illustrations of many interesting installations are included.

BRINELL HARDNESS TESTING MACHINE.—The Scientific Materials Company, Pittsburgh, has issued a 12-page pamphlet discussing the hardness testing of materials with special reference to the advantage of measuring the depth of the indentation made by the testing ball rather than its diameter. A description is given of the improved American model of the Brinell machine, with the appliances for measuring the depth of the penetration as well as other apparatus used in testing of this kind. The pamphlet also contains tables of hardness values.

GENERAL SUPPLIES.—The Gustin-Bacon Manufacturing Company, Kansas City, Mo., has recently issued catalogue No. 5 which gives a general description of the railway material handled by this company. The catalogue is divided into five sections, covering the following articles: Belting and pulleys, hose and tubing, packing and gaskets, mats and mattings, miscellaneous articles, rules and data. It is bound in cloth and is well illustrated. The catalogue contains 215 pages and includes considerable data pertinent to the articles described.

COMPRESSED AIR APPARATUS.—The following new forms have been issued by the Ingersoll-Rand Company, 11 Broadway, New York: Form 8006, a 20-page catalogue on Imperial motor hoists and stationary motors; form 8212, a four-page bulletin on the Crown coal pick and core breaker; form 8213, a 16-page booklet on "Little David," pneumatic chipping, calking and scaling hammers, and form 9102, an eight-page bulletin on air receivers, pressure tanks and moisture traps. The catalogues are profusely illustrated and show tables of sizes and capacities.

JOURNAL BOX PACKINGS.—The Franklin Manufacturing Company, Franklin, Pa., has recently issued a 26-page pamphlet on the subject of journal box packings. It contains interesting information on the general subject, explaining the properties of good journal box packings and the results that should be obtained from it. The method of manufacturing the packings sold by this company is described, and the text is supplemented by interesting photographs. The materials used in the manufacture of packing are also described. A suggested specification for journal box packings is included.

GRINDING AND POLISHING MACHINERY.—The Webster & Perks Tool Company, Springfield, Ohio, has issued an extensive catalogue in loose-leaf binder form, describing its ball bearing and plain bearing grinding and polishing machinery. These machines include all sizes of bench and floor type grinders and wet tool grinders, both with the plain bearings and the ball bearings. This company furnishes some of its floor grinding equipment with direct connected motors. The catalogue contains illustrations of the various types of machines with their specifications, together with a description of the type of bearings used and various attachments that go with the grinders.

GEARED LOCOMOTIVES.—The Lima Locomotive Works, Lima, Ohio, has issued bulletin No. 2 describing Shay geared locomotives for industrial railways. These locomotives are designed particularly to operate on rails having sharp curves and turnouts on which rod connected engines can not operate. They are particularly suited for use in industrial plants as they will accelerate quickly and with them it is easier to spot cars more accurately than with rod connected engines. The bulletin gives an account of tests made with an 0-6-0 type engine and a Shay locomotive of equal tractive effort, to obtain comparative rates of acceleration when working under the same conditions and to determine the time required by the two engines to spot a given car at definite points. A brief description of the Shay locomotive truck is also included.

WOODWORKING MACHINERY.—The Oliver Machinery Company, Grand Rapids, Mich., has recently issued a complete catalogue describing its woodworking machinery and factory supplies. The catalogue contains 301 pages and includes descriptions of the various machines made by this company, including in addition to the woodworking machinery and general material for woodworkers, the Oliver engine lathes, speed lathes and turret lathes for metal work. A complete description is given of each machine and the supplies manufactured by this company, together with a list of the principal dimensions, capacities, etc. Among the products of this company are included wood saws, vises, blacksmiths' tools, clamps, woodworking lathes, metal lathes and accessories used in the woodworking trade. The catalogue is well illustrated and shows all the latest improvements this company has made in its products.